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Volume XIV Number 1

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Published Bi-Monthly By
THE AMERICAN PHYSIOTHERAPY ASSOCIATION
JANUARY—FEBRUARY, 1934
Cleveland, Minnesota, Texas, Washington Number

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Publication Office: 719 Barry Ave., Chicago, Ill.

The Physiotherapy Review

Published Bi-Monthly by The American Physiotherapy Association

Volume XIV January-February, 1934 *Number* 1

Brachial Plexus Paralysis

By John C. Leonard, M. D.*

The brachial plexus is the place of union and redistribution of the nerves which supply the shoulder and arm with sensation and motion. It includes the anterior primary divisions of the 5th, 6th, 7th, and 8th cervical nerves with branches from the 4th cervical and to a greater extent, from the 1st dorsal nerves. Witfi the motor roots are joined the corresponding sensory roots. The spinal segments give off roots, the roots (C5, 6, 7, 8 and D1) form three trunks (upper, middle, and lower) and the trunks in turn form three cords (Outer, Posterior, and Inner). The cords divide into nerves (Radial, Median, Ulnar, etc.) and the nerves give off their various branches.

So far as body landmarks are concerned, it is of assistance to recall that the trunks (and their branches) are at the base of the neck in the supraclavicular fossa, the cords of the brachial plexus are infraclavicular, and the nerves leave the cords in the axilla.

The roots making up the brachial plexus distribute their nerves to the following muscles.

FIFTH CERVICAL

Rhomboids
Spinati
Deltoid
Biceps
Brachialis Anticus
Supinators.

SIXTH CERVICAL

Pectoralis Major (clavicular portion)
Serratus Magnus
Radial Extensors of the wrist
Pronators.

SEVENTH CERVICAL

Pectoralis Major
Triceps
Extensor carpi ulnaris
Extensors of the fingers.

EIGHTH CERVICAL

Flexors of the wrists
Flexors of the fingers.

FIRST DORSAL

Intrinsic Muscles of the hand
Muscles of the first intercostal space.

In general, injuries of the brachial plexus may be divided into supra and infraclavicular lesions, those above the clavicle corresponding to the Erb-Duchenne paralysis, and the infraclavicular lesions corresponding to the Klumpke paralysis. These have also been generally recognized as Upper and Lower arm types of paralysis, a whole arm paralysis being also possible and constituting the sum of the Erb and Klumpke types.

I. Complete Brachial Plexus paralysis.

Etiology: The Etiology may be,

1. Fracture of the lower cervical vertebrae.
2. Tuberculosis or syphilis of the lower cervical vertebrae.
3. Intraspinal tumor.
4. Severe fracture and dislocation of the shoulder girdle or humerus.
5. War wounds, or any penetrating wound such as that caused by bullets, bayonets, glass, etc. Here, it is obvious that any type of lesion may occur.

II. The Erb-Duchenne (Upper Arm) Paralysis.

This is the most common of all. The etiology may be,

1. *Birth Injury:* This happens during delivery and is caused by traction on the head and neck in an attempt to free the shoulder as it impinges behind the symphysis pubis. The acromiomastoid line is greatly increased, thus overstretching or tearing one or several of the component nerves of the upper part of the brachial plexus.
2. *A Fall* (in child or adult) in which the head and shoulder are suddenly and forcefully separated.
3. *A heavy object falling* and striking the patient at the base of the neck.
4. *Compression injury* during extensive period under an anesthetic.

III. The Klumpke-Dejerine or Lower Arm Paralysis.

This type is less common than the Erb type. It is caused by stretching and tearing of one or more of the component nerves of the lower part of the brachial plexus. Etiology.

1. *Birth Injury:* This is not an uncommon occurrence during breech deliveries where the arms become extended above the head and too much traction is then used to deliver the head and arms. Or it may happen where the obstetrician hooks his fingers into the axilla to expedite a difficult delivery.
2. *A Fall* (in the adult) during which the patient reaches out and catches hold of an object to stop the fall, the entire weight of the body being thus suddenly brought upon the lower cords of the brachial plexus (the arm being extended over the head.
3. In reduction of a dislocated humerus by the heel-in-axilla method.

IV. Post Anaesthetic Paralysis.

This has already been mentioned as resembling Erb's palsy. Etiology may be,

1. *Compression* at the base of the neck in the supraclavicular region. This is due to a combination of

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shock position and an extended period under anesthesia.

2. Traction on upper part of plexus due to wide separation of head and shoulder during operation.

3. As a lower plexus injury due to direct pressure of the head of the humerus.

V. Cervical Rib.

This occurs not infrequently and is always a lower plexus injury. It is seen more often in the female than in the male. Only 5 to 10% of those possessing lower cervical ribs have any symptoms at all. The symptoms are usually caused by a fibrous band extending from the cervical rib to the first rib, producing pressure upon the lower plexus and the large blood vessels. There may be posterior fixation of the plexus by a fibrous band, or rarely the plexus may be injured by the sharp edge of a 1st rib. Other factors may be excessive descent of the shoulder at birth, and occupation, or occupation combined with muscular weakness.

VI. Miscellaneous Etiological Agents of Paralysis.

Subclavian aneurism, tuberculous, syphiltic, carcinomatous, sarcomatous or arthritic involvement of the vertebrae, or about the vertebral canal, impinging upon the roots of the plexus.

Immediately after nerve section, vasomotor paralysis comes on and, for several days, the temperature of the paralyzed limb is higher than normal (i. e. vasodilitation and increased blood flow). Then it becomes blue and cold. The muscles degenerate, atrophy, and begin to shorten. Reaction of degeneration soon develops. If the nerve contains sensory fibers, complete anaesthesia to touch, pain and temperature usually follows division, but if the part is supplied by another nerve as well as by the divided one, anaesthesia will not be complete. Trophic changes take place in the paralyzed area. Among these are wrinkled inelastic, or tight glossy skin, cutaneous eruptions, ulcers, dry gangrene, painless felons, loss of hair; brittleness, furrowing, or casting off of the finger nails and even joint inflammation and ankylosis.

Létiévant pointed out that, after the division of a nerve, blunt pressure may be appreciated over the entire analgesic area. This was thought to be due to nerve anastomoses, the sensory areas from different nerves overlapping. More recently, however, the explanation has been given by Sherrington's demonstration that the motor branches of a mixed nerve carry sensory fibers through muscles and tendons and, therefore, carry impressions of deep sensibility, as those produced by pressure.

Stookey says that within twenty-four to forty-eight hours after an injury to a peripheral nerve, the muscles supplied by the nerve will respond to mechanical and to electrical stimulation. Thus the uselessness of immediately carrying out tests for nerve degeneration. After four days a change in the myelin sheath is observed. This is followed by segmentation of the myelin sheath and fragmentation of the neuraxis. At the end of the first week following the injury which caused degeneration, nearly all of the nerve fibers of the distal portion of the nerve present varying evidence of degeneration. The degenerative process is progressive up to the end of the third week, then degeneration reaches a resting stage. After division of a peripheral nerve, the fibers of the distal part must degenerate before onset of regeneration can take place.

The symptoms and signs will depend upon the type of injury, (upper arm, lower arm, or whole arm); the resulting imbalance of muscles; the presence of contractures; and upon whether the nerve interruption is complete or incomplete. With progressive damage downward the sensory changes become wider and more definite. Sensory disturbances will always be present if more than two roots of the brachial plexus are involved. While a great deal of the damage is done by the overstretching and division of one or several components of the plexus, it must be borne in mind that great damage is also done by intra- and extra-neural hemorrhage with resulting scar tissue and contraction of that scar tissue within and about the nerves.

DIAGNOSIS

The diagnosis of the type of injury is made by a careful study of the muscles involved and the areas of complete or partial sensory loss. It must be remembered that the ventral and dorsal roots of a spinal nerve unite within the intervertebral foramen.

I. Section of the Anterior Roots, causes;
   - A. Motor Paralysis.
   - B. Flaccidity.
   - C. Atrophy.
   - D. Loss of Reflexes.
   - E. Reaction of Degeneration.

II. Section of the Posterior Roots, causes;
   - A. Marked ataxia of the arm.
   - B. Anaesthesia (complete).

III. Total Radicular Paralysis (both Anterior and Posterior Roots) causes;
   - A. Complete paralysis of the upper limb.
   - B. Anaesthesia except over parts supplied by C4 and D2 and 3.

In root lesions the loss of pain is more extensive than the loss of *touch*.

In brachial plexus lesions the loss of *touch* is more extensive than the loss of pain.

Paralysis of the muscles of the shoulder girdle means injury at the primary subdivision coming directly from the nerve roots (i. e. supraclavicular).

The nerves with origin in the roots of the brachial plexus are:

1. Dorsalis scapulae supplying the Rhomboidei and Levator Anguli scapulae.
2. Long Thoracic supplying the Serratus Magnus.
3. Phrenic Nerve supplying the Diaphragm.

Dropping of the humerus with elongation should always be looked for, since it always indicates a supraclavicular lesion.

Injuries of the Outer Cord:

These give paralysis of the biceps, coracobrachialis, brachialis anticus, and the radial flexors of the wrist and fingers. There is also sensory loss on the outer aspect of the forearm.

Injuries of the Inner Cord:

These give paralysis of the flexor carpi ulnaris; the inner half of the flexor profundus digitorum, and all the intrinsic muscles of the hand. There is loss of sensation over the inner half of the forearm and hand, the little and ring fingers. Horner's syndrome is sometimes present here. It consists of:

1. Enophthalmos.
2. Pseudoptosis.
3. Constriction of the pupils.
4. Absence of sweating half the face (on the side of the injury).

Injuries Due to Cervical Rib:

These may be divided as follows:

1. Local pain, swelling, pressure, bruit.
2. Neuritic type of pain, worse at the end of the day's work.
3. Vascular with pulsation, ischemia, or even thrombosis and gangrene.

4. Muscular with fatigue, atrophy and great pain with arm hanging at side, relieved with arm raised.

In these patients a point of diagnostic value is this: depression of the shoulder may obliterate the radial pulse, with return of the pulse when the shoulder is again elevated. Thus it is readily seen why there may be circulatory changes present in this condition.

It is useless to attempt to make accurate diagnosis of the exact location of brachial plexus lesions without having a detailed knowledge of the construction of the plexus itself, as well as a thorough knowledge of the anatomy of the shoulder girdle and upper extremity. It must be borne in mind that there are several variations in the construction of the plexus, of which the diagram is only one; that injuries may give complete or incomplete anatomical, *or* complete or incomplete physiological pictures; and that a muscle may receive its innervation from more than one nerve, thereby complicating diagnosis. Another point that must be remembered is that nature has provided several muscles or muscle groups for each motion, and that the most careful and painstaking observation is often required in order to satisfy ourselves (in incomplete lesions) as to which muscle is paretic or paralyzed.

In carrying out examinations preparatory to making a diagnosis, the following points are important.

1. Be careful not to antagonize the patient. Screen the part to be tested, for too much cooperation on the part of the patient is just as bad for results as lack of cooperation. Do your best to gain your patient's confidence.
2. Use the simplest methods at your command.
3. Be sure that your patient is comfortable and warm and that you are not in a strained, uncomfortable position.
4. Be systematic, gentle, and avoid unnecessary repetition.
5. Do not wear your patient out. If the examination is extensive divide it into several sittings.
6. Be certain that the muscle under investigation is really performing the motion desired.
7. Be sure that your patient is responding to pain and not just to deep pressure.
8. Be sure to distinguish between zones of total and partial sensory loss.
9. It is usually unnecessary to investigate thermal sensibility *except where a spinal cord lesion is suspected.*

AMOUNT OF DAMAGE

The findings on examination will vary with the extent of the damage done. They may be divided into the following groups.

I. Very Slight Damage.

Overstretching of the upper portion of the brachial plexus without laceration. Here we will find:

1. Partial or complete loss of power in the shoulder cap group of muscles, notably the *deltoid.*
2. Inability to abduct the arm.
3. Inability to externally rotate the arm.
4. Slight interference with flexion at the elbow.
5. Slight interference with supination of the forearm.

II. Moderate Damage ((Erb's or Upper Arm Type).

Overstretching with laceration of the upper two roots (C5 and 6). Overstretching and slight laceration of C VII and overstretching of C VIII and D I.

1. If a birth injury, the diagnosis is obvious at birth or within two to seven days thereafter.
2. The entire extremity is paralyzed except for motion in the fingers and very slight motion in the wrist.
3. Flexion is stronger than extension.
4. The arm will be rotated inward, the elbow straight, and the forearm pronated.
5. Paralysis will be flaccid.
6. There may be a soft tender mass above the clavicle.

III. Severe Damage.

Here there is serious injury to all roots with laceration, occasional rupture and perhaps displacement of roots CV, VI, and VII. C VIII and D I are seriously lacerated but not often completely ruptured. The roots may be avulsed from the spinal cord. Here there will be—

1. Primarily complete flaccid paralysis. After several months there may be slight motion in one or all fingers.
2. Unbalanced motion in the wrist.
3. The arm will be thrown about flail-like. (The shoulder here is a "flail-joint.")
4. The muscles will be thin and flabby.

IV. Complete Damage.

All roots here are so badly lacerated and damaged that the resulting scar prevents nerve regeneration. There may be avulsion.

1. There will be complete flaccid paralysis.
2. There will never be any spontaneous recovery.
3. Horner's syndrome will be frequent.

V. Reversed Paralysis (Klumpke's Lower Arm Type) here C VIII and D I are damaged. The upper roots escape injury.

1. There will be good shoulder and elbow function.
2. There will be an almost useless hand and wrist.
3. Horner's syndrome is usually present.

REACTION OF DEGENERATION (R. D.)

After division of its motor nerve, a muscle ceases to respond to stimulation with the interrupted current applied over its motor point. This change comes about, according to Sherren, in from four to seven days. At about the tenth day it may be extremely difficult to obtain any contraction to the constant current, and at or about this time the muscles respond to this form of stimulation with a sluggish, wave-like contraction, starting at the spot stimulated; and a stronger current must be used to call it forth than on the sound side. The anodal closing contraction (A. C. C.) is greater than the (K. C. C.) cathodal closing contraction, which is just the reverse of normal. To this loss of irritability to the interrupted current with this specific alteration in the type of contraction given to stimulation with the constant current, the name Reaction of Degeneration (abbreviated R. D.) is applied. R. D. then is (briefly) the absence of response to faradic, and a slow contraction with the galvanic current.

The length of time after separation from their anterior horn cells that the muscles retain the power of reacting to stimulation with the constant current varies. So long as contractile substance is present in the muscles, they will respond to this stimulus. When once a muscle has lost the power of responding to this current its recovery is impossible. The longest period recorded has been twenty-three years. If faradic response is present there is no necessity to test for galvanic response. In compression paralysis the electrical reactions may (occasionally) be normal. Preliminary to testing for electrical response, the arm should be thoroughly warmed (15 to 20 degrees with lamps), and any edema present, reduced by massage.

REGENERATION—RECOVERY—PROGNOSIS

Regeneration (or downgrowth of nerve fibrils) proceeds at the rate of 1 to 2 mm. per day. The nerve fibers which convey impressions of cutaneous pain and of extreme heat and cold regenerate much more rapidly than those which subserve sensations of light touch, and slight degrees of heat and cold. The investigations of Head and others show that restoration does not begin at the edge of the normal area and spread from there over the anaesthetic area, but that the reverse of this is the case. Thus it begins within the confines of the anesthetic area and slowly spreads toward the normal part.

When a nerve has been divided and has not been sutured, abolition of function may be permanent or restoration may occur. Sensation may return in from six weeks to several months. Motor power may never return. If it does return it will be long after sensory restoration. Restoration of motor function, that is, power, requires from three months to three and a half years. It is seldom noted before six months and the return is always slow. Irritation of a nerve causes hyperhidrosis (increased sweating), while complete paralysis causes anhidrosis (absence of sweating) over the area supplied by that nerve.

TINEL'S SIGN

An early sign of recovery is a diffuse sensation of tingling ("pins and needles") in the peripheral distribution of a nerve, evoked by gentle percussion well below the level of injury or suture.

The earliest manifestations of nerve recovery are subjective. The patient will say, "It feels different," or "It feels more lifelike." Accompanying this is a palpatory impression of the slightest evidence of better tone to the muscle. Then comes increased response to deep pressure and slight return of sensation to pin prick. After one and a half to four months, the area of analgesia begins slowly to grow smaller. Then may follow a period of abnormal response to painful stimuli with increased discomfort to the patient, which however, is welcomed as a good omen. Then the skin loses its cyanosis; sweating returns; any sores and ulcers which may have been present begin to heal. There is a return of two-point discrimination and the ability to distinguish between finer degrees of heat and cold. Response to all sensory stimuli may be normal after eighteen to twenty-four months, or it may not be for several years.

Recovery of motor function is slower. The tone of the muscle gradually improves, it takes on a firmer, fuller appearance until it is definitely harder to palpation. A strange finding is that voluntary contractibility of the muscle frequently precedes the return of faradic response. Regeneration and recovery of function will be influenced by—

1. The general health of the patient.
2. His ability to keep in good physical condition, thereby maintaining an efficient cardiovascular system with its resulting beneficial effect upon the paralyzed extremity.
3. The method of healing (if surgical), whether suppurative or not.
4. The condition of the muscles. They must not be excessively atrophied or fibrosed.
5. The condition of the joints. They must not be stiff.
6. The mental condition of the patient. He must be "recovery minded" and he must have the "will to do," which makes it possible for him to use the muscles as their power slowly returns.

DIFFERENTIAL DIAGNOSIS

Careful inspection with the patient stripped to the waist is important in differential diagnosis. The x-ray is often of great assistance in ruling out fractures and abnormalities of the vertebrae which cause lesions which may closely simulate a primary brachial plexus injury. Sensory examination of the body on the side opposite the paralysis (testing for loss of pain, heat and cold below the level of the lesion); increased reflexes; and the positive Babinski response, are of value in ruling out primary brachial plexus lesions. Careful observation of the presence of shoulder girdle involvement, or the presence of Horner's syndrome, also aid greatly in diagnosing the location of the lesion. The presence of normal response to the electric current, together with the finding of glove or stocking-like distribution of anaesthesia, relieves one of the embarassment of being deceived by Hysterical Paralysis or "Compensation Paralysis."

COMPLICATIONS

A few of the complications of Brachial Plexus Paralysis which should be kept in mind are—

1. Fracture of the humerus.
2. Cerebral and spinal cord injuries.
3. Hematoma of the sternocleidomastoid muscle.

SEQUELAE

Some of the common sequelae are—

1. Subluxation of the shoulder.
2. Wing scapula.
3. Scoliosis (cervicodorsal) in the infant or child.
4. Characteristic awkwardness.
5. Unstable gait (in the infant).
6. Trophic disturbances with their occasional serious consequences.
7. Psychic disturbance from the knowledge of being "crippled."
8. Handicap with regard to physical pursuits.

PROPHYLAXIS

It is useless to say, "Avoid injury to the brachial plexus," but the practice of careful obstetrics and close attention to the position and condition of the arms and shoulders of the patient on the operating table, will materially reduce the incidence of brachial plexus injuries. However, there are cases of Birth Palsy recorded which took place with neither a doctor or a midwife in attendance.

TREATMENT

Operative and conservative (non-operative).

Indications for Operative treatment are—

1. Total loss of function in an area exclusively supplied by the nerve, persisting after two months (according to Riddoch and the more radical surgeons) or after six to twelve months of the proper treatment, the time set by the more conservative surgeons (Taylor, for example).
2. Palpable neuroma or neuromata at the site of the injury of the nerve, the function of which is seriously disturbed.
3. Extremely slow recovery, cessation of recovery, or relapse.
4. Severe, persistent, and intractable pain.

Contra-indications for Operative treatment are—

1. Presence of infection, that is, an unhealed suppurating wound.
2. Progressive spontaneous recovery.
3. Area inaccessible to operative treatment where

surgical trauma may cause even more extensive damage than is already present.

Brachial plexus lesions are primarily a *traumatic neuritis*. Once the palsy has occurred treatment should begin at once and should be systematic, rational and continuous until all possible recovery has taken place, even though this might cover a period of years. Of all the peripheral nerve lesions, none require more constant and efficient mechanical treatment than these. Points of extreme importance in treatment are—

1. *Rest.* Therefore, it is extremely important that the extremity should be subjected to no manipulation or massage over the brachial plexus or upper arm while pain and sensitivity are present. This period may last from four days to three weeks in incomplete lesions. However, during this time, lower arm massage and careful motion (passive) are safe. This bridges over the period while the traumatic neuritis persists. In removal from the splint for bathing, etc. the arm should be handled and moved with the greatest care. Place the nerve and muscle in a favorable position for recovery. Give them the best possible relaxation; for a stretched muscle, even though it retains its nerve supply will not regain its strength and ability to perform its normal functions.

2. Not only prevent the stretching of muscles by gravity, but prevent contractures, which take place by normal muscles exerting a pull upon those muscles which have been deprived of their nerve supply. Points one and two therefore call for corrective splinting. The aeroplane splint is the ideal means to this end. In the aeroplane splint there is abduction at the shoulder to 90′; flexion to 90′ at the elbow; external rotation of the humerus; supination of the forearm; extension of the hand, wrist, and fingers in a straight line with the forearm. An ordinary sling with so-called support at the elbow and with the arm at the side, is useless, harmful, and distinctly contraindicated. In this connection it is well to remember that contractures will develop in six to eight weeks, occasionally even in three weeks. Splints must be light, well-fitting, and as comfortable as possible. Watch for pressure sores.

3. *Nutritional Treatment.* Maintain muscular nutrition by means of heat, massage, passive motion, and electrical stimulation. This will also keep the joints mobile so that when there has been nerve regeneration, the nerve will find its muscles in condition, ready for response. These will be dwelt upon in more detail.

(a) *Heat:* Improves the nutrition of the muscle by increasing its circulation. It may be applied with benefit for twenty to forty-five minutes per day or twice a day. Be careful over anaesthetic areas.

(b) *Massage:* During massage be careful not to place a stretch upon either the brachial plexus or the denervated muscle. The value of massage lies in its stimulation of the circulation, absorption of fluid (lymph and any edema present) and the prevention of excessive muscular atrophy. It has been shown that even the finger nails grow less slowly when massage is practiced every day.

(c) *Passive Motion:* Here again, avoid any pull upon the plexus. Passive motion should always be done slowly and gently. Its nutritional value is also to force the lymph and the products of metabolism from the muscles. Therefore, it is best carried out in conjunction with massage. It helps to avoid contractures by stretching the developing fibroblasts. It keeps the joints mobile and is the first step in re-educating the affected muscles.

The Whirlpool Bath is also of great value here since, (while it does not "beat, as it sweeps, as it cleans") it does warm, as it soothes, as it massages.

(d) *Electrical Stimulation:* Piontkowsky has recently shown that a more advanced type of nerve regeneration occurs when the denervated extremity is treated by Electrotherapy. Electricity should be used only by expert technicians. The treatment is of individual muscles and muscle groups, therefore, a knowledge of anatomy is essential. Home treatment with small batteries is of no value. Treatment should be from twice a day (which is the optimum) to at least three times per week. The Bristow unit is very efficient in this treatment.

1. Electrical stimulation provokes contractions in muscles where voluntary action is absent.
2. The results are always better if the limb is heated prior to treatment.
3. Use the weakest effective current.
4. Between treatments it is best to keep the arm warm with a long stocking or glove. This provides both warmth and protection.
5. Electrical stimulation thus helps to prevent atrophy and fibrosis, increases muscle nutrition, and conserves the functional capacity of paralyzed muscles until there is enough nerve regeneration to permit active, voluntary motion.

4. *Re-education.* Re-educate the patient in the use of his muscles when once conduction in the nerve becomes established. Otherwise the strong muscles will compensate for the weak, at the expense of optimal recovery. Muscle training requires great skill, tact, and patience, especially in infants and children.

(a) Do not work against gravity.

(b) A smooth, powdered board is a great help by its minimum amount of friction allowing the patient to use even slight voluntary muscle power.

(c) Hydrotherapy and Exercise under water are also invaluable aids.

(d) Watch for and avoid trick movements by the use of neighboring healthy muscles.

(e) Assist all motions at first. Do this less and less as recovery reappears; but it is useful to go through the motions of helping for psychic effect.

(f) Avoid fatigue. Stop short of this point or definite damage will be done to weak muscles.

Although active movements of muscles paralyzed as the result of complete section of the nerve do not occur before the end of the fourth month, these exercises may be begun after the third month following injury.

SURGICAL (OPERATIVE) TREATMENT

There are, of course, conflicting views concerning the surgical treatment of brachial plexus lesions. It is generally conceded that in severe plexus injuries where there has been a great increase (i. e. wide separation) of the acromiomastoid line, there is certain to be extensive local damage (both intra- and perineural) which, if not interfered with, would lead to the formation of such extensive scar tissue that nerve regeneration would be impossible. Here, surgical intervention should be carried out early, and better results will be obtained; not to mention the months to years of time saved in convalescence. There are quite a few instances cited, and more seem to be accumulating steadily, where almost simultaneously with surgical intervention, the opening of perineural sheaths, evacuation of blood clots, and suture of divided ends, there was return of sensation to anaesthetic areas with beginning return of motor power.

Many surgeons who are keenly interested in this subject feel that the distal part of a traumatized or divided

nerve is very resistant to degeneration and that return of function may, with proper treatment, be obtained months and even years postoperatively.

However, for other than the severe plexus injuries, the conservative plan of treatment is, at the present time, the unanimous choice.

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Chronic Back Strain

A Review of One Hundred Cases Treated Conservatively

By John G. Kuhns, M. D.*

"The prime object of the physician in the whole art of medicine should be to cure that which is diseased; and if this can be accomplished in various ways, the least troublesome should be selected," said Hippocrates[1]. There are many ways of treating chronic strain of the back and there is no unanimity as to which is the best method in any particular instance. For most patients with chronic strains of the back the least troublesome form of treatment is one in which rest and the restoration of the best mechanical alignment of the spinal column form the chief parts. This paper is a review of one hundred patients with chronic strain of the low back treated in this manner where a sufficient period has elapsed, two years or more, so that a fair appraisal of therapy can be given.

The term "back strain" usually connotes injury in the region of the lumbo-sacral or sacro-iliac joints. There is need for a far more comprehensive understanding of chronic strains of the back.[2] While the joints attaching the spine to the pelvis are the ones most commonly strained due to the leverage action of the spine in the orthograde positions, other parts of the back may be injured also, sometimes concomitantly with the low back injury. This is particularly true of the dorso-lumbar and cervico-dorsal junctions of the spine. The locations of the injuries will be dependent upon mechanical forces acting upon the supporting structures of the various portions of the spine at the time of injury. That portion of the spine which is most weakly supported or upon which the greater straining force is acting will be injured. The combinations of strains observed in this series are shown in Table 1: These diagnoses were made by the usual methods of determining such injuries[3], [4], [5].

TABLE 1. THE LOCATION OF THE STRAIN IN 100 PATIENTS

Lumbo-sacral	53
Sacro-iliac	13
Combined lumbo-sacral and sacro-iliac	21
Combined lumbo-sacral and dorso-lumbar	10
Combined lumbo-sacral and cervico-dorsal	2
Lumbo-sacral with spondylolisthesis	1

It is not uncommon to find a fairly widespread injury of the spinal ligaments even in chronic cases, not only with the usually recognized clinical evidence of ligamentous injury but with the signs of such injury in the X-rays as well[3], [6]. The spinal and pelvic ligaments are so intimately combined that it seems almost impossible to produce a ligamentous injury referable to but one spinal or pelvic joint[7]. There are a number of factors which help to determine to a certain degree the areas in the spine which will be affected chiefly. The type of body-build[8] which the individual has inherited may make him more or less susceptible to strains of the back. It is a fact well recognized in industry that the stocky type of individual is preferred for occupations which require heavy lifting, since in such work the slender type of individual is more apt to suffer from spinal injuries. In this series there were fifty-three individuals of the slender type, thirty-nine of the intermediate type and eight of the stocky type. In the eight individuals of the stocky anatomic type all of the strains were of the lumbo-sacral joint. One frequently finds an injury to the back localized either to the lumbo-sacral or the dorso-lumbar region of the spine in the heavy anatomic type of individual. This is due chiefly to the heavy vertebrae, to the short ligamentous attachments of the spine, to the deep crescentic articular facets, and to the low position of the sacrum. Such spines are more stable so that injury is less likely to occur, but those regions of the spine where the greatest range of motion takes place remain the most vulnerable portions.[9].

More important than the anatomic structure of the spine in different individuals is the way that the spine is habitually used. If the body is carried well poised with no increase in the normal antero-posterior curves, the weight of the head and thorax will be carried upon the vertebral bodies and upon the intervertebral fibro-cartilages. In this way there will be no undue stretch upon the supporting muscles and ligaments, and strain of the back cannot so easily occur. If, however, the body is used poorly poised there will be an increase in the normal antero-posterior curves usually with an increased forward inclination of the pelvis, with varying degrees of relaxation of the muscles and ligaments posterior to the vertebra and with consequent shifting of a certain portion of the superincumbent weight of the

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body to the tips of the articular facets[10], and in the low lumbar region, occasionally to the spinous processes as well. In the lumbar spine increased lordosis may lead to impingement of the spinous processes and sometimes to actual overriding of one spinous process upon another[11]. The muscles not being in proper balance, because of the change in the distance between origin and insertion, cannot function normally, and an increased pull is exerted upon the ligamentous structures which aid in supporting the spine. When the spine is used habitually in the position of extreme extension in the lumbar region any sudden unguarded movement may produce a strain of the low back. It is interesting to note that in these one hundred cases all of the individuals had very badly poised bodies, with postures of the C and D class. Henry,[12] who included both acute and chronic strains in the one hundred cases he studied, found D posture in twenty per cent.

A fairly large number of those patients, thirty-four, showed congenital abnormalities of the spine,[13] Table 2. The usual location for such abnormalities was the low lumbar or lumbo-sacral region of the spine, probably due to the relatively recent adaptation of this part of the spinal column to the orthograde position. The most common of these abnormalities were variations in the size, shape and directional slant of the articular facets of the vertebrae.[14]. Flat articular facets on one side of vertebrae and crescentic facets on the other side were found in four spines. In such cases there was a tendency to increased motion on the side of the flat articulation and increased stability on the side of the crescentic articulation. There were four slender individuals in this series whose spines showed six lumbar vertebrae and there was one individual of the stocky anatomic type with four lumbar vertebrae. An increase in the number of vertebrae in the lumbar spine usually permitted greater motion and a decrease tended to greater instability. In one patient there was a marked increase in the size of the last lumbar vertebra in relation to the other lumbar vertebrae, commonly called platyspondylisis.[15] There were very large transverse processes of the fifth lumbar vertebra in five cases, four showing a unilateral lumbo-sacral transverse joint and one showing it bilaterally. A spina bifida occulta of the lower lumbar spine and sacrum was observed in four cases. These abnormalities tended in various degrees to weaken the support of the spine by lack of bony attachments for ligaments and muscles and by a change in the motion and stability on one or both sides of the vertebrae.[16]

TABLE 2. SUMMARY OF FINDINGS IN X-RAYS

Cong. abnormalities of spine (in toto)	34
Malformation of articular facets	13
Spina bifida occulta	4
Lumbo-sacral transverse joint	5
Numerical variation in lumbar spine	5
Spondylolisthesis	1
Structural, lateral curvature	13
Displacement of sacro-iliac joint (slight)	2
Malignancy	2

Overriding or apposition of spinous processes particularly in the lumbar spine is rarely mentioned in reports upon X-rays. Yet, this constitutes one of the most common deviations from the normal that is seen in X-rays in cases of chronic spinal disability. Antero-posterior X-rays will often show a widening of the tips and a lateral deviation of the spinous processes in the lumbar vertebrae. In lateral X-rays the spinous processes may be seen in contact or with their X-ray shadows partially superimposed. These changes in the spinous processes are not found in young children. They develop in the individual as far as can be determined, only with long continued hyperextension of the lumbar spine. They are an indication of improper poise and of long continued hyperextension of the lumbar spine. These changes in the spinous processes are observed far more commonly in the slender anatomic type of individual since a greater range of motion is possible in the spine in this type.

Generalized atrophy of the spine was observed in sixteen individuals. It is looked upon as one of the early signs of atrophic arthritis, a not uncommon sequel to chronic strain of the back.[17] In this series, no cases of out-spoken arthritis of the spine were included. Mild hypertrophic arthritis was observed in the spines of seven elderly individuals.[18] Structural lateral curvature was observed in thirteen patients. The milder degree of lateral curvatures of the spine often cause no definite symptoms in early life, but later, with the decrease in the resiliency of ligaments, and with poorer muscular tone, they play no small part in disturbing the balance and mechanical stability of the spine.[19] Displacement of the sacroiliac joints which was mentioned not infrequently in the earlier literature upon strains of the pelvic joint was observed in only two patients.[20] Disalignment in the symphysis pubis was observed in no instance. One is led to believe that while these changes may be occasionally demonstrable in the X-rays taken following an acute injury, they are very rarely found in the chronic strains of the back. A reduced lumbo-sacral joint space was not found in any of these cases.[21] Malignancy which occasionally masquerades as a chronic injury of the spine was observed in two patients in this series. In one patient the X-rays showed involvement of the vertebrae only after the patient had been under observation for one year.

All of the strains of the back reviewed in this series were chronic in nature. The shortest period of disability was six months and the longest was thirty years. The average was a little more than six years. In fifty of the patients there was no definite onset of symptoms, only a gradually increasing awareness of discomfort and of pain on motion with a subsequent curtailment of activity. Eight developed during or immediately following a pregnancy. In the other forty-two patients there was an abrupt beginning of symptoms usually following a bending or twisting motion of the spine. The precipitating causes in these forty-two patients are listed in Table 3.

TABLE 3. IMMEDIATE CAUSE OF STRAIN

Stooping and lifting	11
Fall—striking pelvis or back	10
Stroke of arm (tennis or golf)	6
Collision (train, motor car)	6
Long driving (motor car)	5
Blow on hip	2
Following abdominal operation	1
Long standing	1

The pathological changes that have been considered in such strains of the back have usually been a tearing of one or more ligaments about the injured spinal or pelvic joints with subsequent hemorrhage, exudation of serum and swelling, followed by attempts at repair.

In the patients with a history of an acute onset

of symptoms, the mechanism of the trauma producing an undue stretching or tearing of ligaments is readily understandable. It is well known that when joints anywhere in the body are not adequately protected by the muscles either through faulty function of tonic and co-ordinating mechanisms as in "unguarded movements" or through fatigue, the pull comes upon the ligaments, the ultimate supporting structures of the joints.[22] If this pull is sufficiently intense or long continued, injury to the ligaments occurs. In the strains of the back coming on during and subsequent to pregnancy there are usually two factors of etiological moment.[23] Probably the most important of these is the change in the carriage of the body which comes with pregnancy unless adequate support is given to the abdomen. With the enlarging uterus there is backward inclination of the torso with markedly increased lumbar lordosis and gradual stretching and weakening of the anterior abdominal muscles, the so-called anterior supports of the spine. The second factor is the gradual relaxation of the pelvic joints coming on with gestation.

The etiological factors in the cases of back strain where symptoms developed slowly could be determined in most instances. As far as we could ascertain, the pathological changes were similar to those which were found in the spines where symptoms had developed acutely. The chief causative factor in this series was the faulty use of the body, as seen in the very poor posture of these patients.[24] If the lumbar spine was used at the extreme of extension, further pull of the muscles in extension produced a strain in this region. The fatigue and sense of decreased well being, natural sequelae of the faulty use of the body, also helped in bringing on strain. Increased lumbar lordosis while very common, was not always found in these badly poised individuals. A relatively flat lumbar spine was seen in three patients. In these three there was an abnormality in the articular facets of the lumbar spine.[25] In this series there were no cases due either primarily or secondarily to gynecological[26] or urological disturbances although there were seventy-six women among the patients studied. The symptomatology in such genito-urinary lesions has been somewhat different and, particularly in the chronic cases, lesions of this type usually have been eliminated in the early study of the patient.

All of these patients, since they had been physically handicapped for a long time, had developed in many cases a distorted point of view in regard to their illness, a fact well known and frequently mentioned by industrial surgeons. Probably the most common was a fear of permanent disability with a gradual adjustment of the personality to an acceptance of partial or complete invalidism. No cases of hysteria or malingering were observed. While in the majority of the cases there was a misinterpretation and often an exaggeration of symptoms, in all, definite clinical, and almost always, roentgenological signs were present. All of these patients had previously undergone treatment of one type or another with subsequent loss of confidence in physicians; many had consulted irregular practitioners. The most grave fault in the therapy given had been a lack of appreciation of the serious nature of the difficulty and a misunderstanding of the location and kind of injury which had occurred. Table 4 gives a summary of the previous treatments given:

TABLE 4. PREVIOUS THERAPY

Medicines (including endocrine therapy and dietary regulation	40
Spinal support (various types)	13
Rest in bed	12
Abdominal operations	7
Removal of foci of infection	5
Osteopathic treatment	5
Chiropractic treatment	4
Rest in bed and spinal support	2
Manipulation by physician	2
Treatment of foot strain	2
Fusion of both sacro-iliac joints	1
Exercises	1

It was surprising to see so many patients with definite clinical signs of strain of the back where the obvious physical findings were ignored and some occult physiological disturbance was sought which might respond to medication. While the patient should be considered as a whole, and general, as well as local measures, should be used in most instances, the strain of the back offered definite indications for at least a portion of the therapy since all of these patients sought relief for pain in the back. In practically all of the cases there were underlying factors which had to be recognized and treated if a return of the disability was to be prevented, but the immediate illness required attention first with treatment which was adequate in character.

One rarely finds a chronic back strain alone. There are usually signs of strain and of faulty use of other parts of the body as well. There was an associated foot strain in twenty per cent of the patients.[27] In twenty-five per cent there were signs of irritation, a so-called traumatic arthritis, in the X-rays of the spinal and pelvic joints involved. Among the non-spinal complaints listed, chronic constipation was most common, being found in thirty-six patients. Various digestive disturbances were observed in eight cases more. There was a wide variety of complaints in the remainder of the patients for which no pathological change could be found and which disappeared as the strain of the back subsided. Many of them were probably due to physiological disturbances associated with the extremely faulty posture of the body as observed in all of these patients.[28]

A tabulation was made of the location of the tenderness and muscle spasm, and of the distribution of pain over the back, abdomen, and legs. In the majority of the cases there was radiation of pain either to the posterior aspect of the thigh or to the outer side of the thigh, often extending to the foot, with a somewhat similar radiation of pain in both lumbo-sacral and sacro-iliac strain.[29] Much has been written in regard to the distribution of pain as an aid in the differential diagnosis of strains of the low back.[30] In this series, such findings were of no definite value. Stretching in the original injury, pressure from swelling in the neural foramen and secondary inflammation to contiguous structures have been suggested as causes of the inflammation of the nerve. Pain may also originate, as Tschurjew[31] has shown, through painful sensations, arising in the injured ligaments themselves, which are referred reflexly through the spinal segment from which the nerve arises.

The treatment of a chronic strain of the back is not a simple problem and the problem becomes more complex with each acute exacerbation of the difficulty. There are many phases of therapy upon which there is wide disagreement, and it is not the purpose of this paper to discuss controversial points. A simple description of the treatment and of the results obtained will be given. All

of these patients were treated conservatively.[32] Surgery was only undertaken when relief was not obtained after prolonged conservative treatment. The treatment at first consisted of rest in bed with an attempt to prevent further irritation of the spinal ligaments and joints. The patient was kept continuously on a firm bed so that sagging of the body was prevented; flattening of the lumbar spine was obtained by a pillow under the thighs. The patient was not permitted to be propped up with pillows, since it was believed that the more nearly horizontal the body was kept the easier it was for repair of the strain to take place. Heat was given in the form of hot compresses to the spine for about one-half hour several times a day. Partial relief was usually obtained in several days. Exercises were then begun which were carried out with the patient lying down. These were given to make it possible to decrease the lumbar curve of the spine voluntarily and to hold it by muscular effort. No exercises were given for the legs until all muscle spasm had disappeared. After a fair degree of competence in holding the lumbar spine flat had been gained, and the severe symptoms had subsided, the patient was allowed up for gradually increasing intervals.

With the assumption of the upright position a spinal support was usually fitted which assisted the patient in maintaining good poise and in holding the strained portion of the back in the best mechanical position. The exercises and the spinal support were continued until the patient was not only free from symptoms but was also able to hold the back and the body in good poise without fatigue. In certain of these individuals advice had to be given so that the positions of sitting in motor cars or at desks would not strain the back again through the assumption of extremely faulty attitudes. The full cooperation of the patient was required since cure, if it came, resulted from this change which the patient made in the use, and in the development of muscular control, of his back. While the period of such treatment was sometimes prolonged where the strain has been particularly long-standing, and where there were associated congenital abnormalities which made the spine weaker, cure was still possible and permannce of cure depended upon the patient's ability to use his back rightly. In only four cases was surgical intervention necessary subsequently.

When the faulty hygiene, the bad posture and the poor muscle tone of the patient had improved, cure for all practical purposes had taken place. Many of these individuals had no further recurrence of their backstrain. In one patient with spondylolisthesis, after only partial relief from conservative therapy, a lumbo-sacral fusion was performed. A similar operation was necessary in another patient with lumbo-sacral strain where a unilateral long transverse process was present on the fifth lumbar vertebra. In two others, one primarily a lumbo-sacral strain and the other a strain of the sacro-iliac joint a manipulation under anaesthesia was required in order to free adhesions which prevented the patient from getting into a position free from strain. In the remainder of the patients, relief of symptoms was obtained in all except two patients with malignancy and three others in whom an atrophic arthritis subsequently developed.

The time that these patients were kept continually in bed varied from five days to seven weeks. The average period was twenty-three days. Following this, treatment with a spinal support and exercises was continued for a number of months, in most cases with the patients at their usual occupations. The therapy was given primarily for the immediate disability but where the patients were willing to work sufficiently hard, better function and strength was secured in the muscles which supported the spine, and an habitual carriage of the body was obtained in which the spinal joints were used approximately mid way between full flexion and full extension. This with a good hygienic regimen of living seemed to offer the best means of preventing recurrences of the back strain.

CONCLUSIONS

In a review of one hundred cases of chronic back strain the chief underlying factor found in both their etiology and continuation was the incorrect mechanical use of the body. Ninety-one of these patients recovered entirely under a regimen of rest and of exercises given to improve the position of the spine and to make it more stable. All except two of those showing congenital abnormalities in the spine obtained lasting relief of symptoms from such treatment alone. The chief fault in the original therapy which failed to cure the acute strain was a misunderstanding of the seriousness of the injury, usually with treatment continued for too short a time. While operative procedures were sometimes necessary to obtain a cure in chronic strain of the back, almost all of these patients obtained lasting relief from their disability by striving hard enough and long enough to develop proper functioning muscles and the best mechanical alignment of the spine.

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Well-Leg Method of Treating Fractures of the Femur

Roger Anderson, M. D.*

This new method of fracture treatment for the hip, pelvis and femoral shaft holds special interest for the physical therapist. The established method of treating hip fractures has been chiefly encasement of the whole extremity and a large portion of the trunk in a spica cast, prohibitive to local physical therapy. With this new method the fracture is immobilized by encasing only a small portion of the injured leg in a plaster boot and extending the cast only to the thigh on the well leg, leaving the rest of the body exposed.

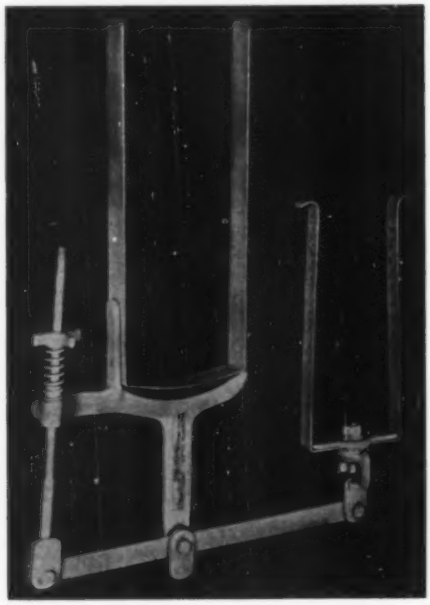

Fig. 1. The Well-Leg Splint. The larger or left portion of the splint is attached to the cast on the well leg, while the smaller stirrup on the right is incorporated in the plaster boot on the injured leg. The turning of the nut on the left supplies the traction force, while rotation is controlled by the small lock nut on the right.

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Fig. 2. Mrs. T. J. with a right subtrochanteric fracture sat up on the back rest from the first day, thus avoiding the dangers of pulmonary complications. Note exposure of knee, thigh and hip on injured side.

This method depends upon a fundamental principal: skeletal traction plus countertraction derived from the well leg. So perfect is the mechanism of the Well-Leg Splint that turning a nut by the fingers alone controls all traction, a powerful force which pulls the injured hip down, simultaneously forcing the well acetabulum up, resulting in abduction at the hip. Although easy in application the apparatus has a wide range of adjustability, for abduction or adduction and internal or external rotation may be had at any time without letting up on traction.

In the past the majority of orthopedic men have been treating fractures of the hip by the Whitman method, the chief principles of which are fixation of the fracture in abduction and internal rotation, but with this method immobilization depends upon a spica cast which encases most of the patient. Advocates of this method recognize its limitations, for it is necessary to give a general anaesthesia and to apply a heavy wet body cast during the post-anaesthetic period, augmentative to shock in elderly patients. Another disadvantage is that the patient must lie flat in bed, unable to breathe deeply because of the cumbersome cast, the reaction being circulatory embarrassment, conducive to such conditions as hypostatic pneumonia. Moreover, as the body is covered with a cast, there is impairment of the digestive function.

Fig. 3. Mr. J. C. The fractured right hip did not prevent the patient from exercising daily, which kept up his morale, stimulated respiration and improved circulation, besides minimizing nursing care.

Fortunately, with the Well-Leg Splint we are

Fig. 5. Mr. M. T. (a) Comminuted fracture shaft of right femur. (b) Reduction obtained with Well-Leg Splint.

able to obtain abduction and to have direct positive control over internal rotation, and at the same time, sufficient immobilization so that these fractures of the hip are now treated without resorting to the spica cast.

MODE OF REDUCTION AND ADVANTAGES THEREBY

Immediate reduction with the resultant lessened edema and reduction itself under local anaesthesia are conducive to early physical therapy and are of shock-saving import. To avoid augmenting trauma the management of the case can be carried out entirely on the same hospital cart on which the patient entered. After the preliminary hypodermic and X-ray a cast is applied to the well leg, and while drying, the pin or wire is inserted through the lower end of the tibia under local anaesthesia. A short plaster boot is next applied incorporating the pin, whereupon the small portion of the splint is attached to the injured side, with the larger portion to the well leg. Reduction is then completed, accomplished by turning down the traction nut, after which the position is radiographically checked. This, in brief, summarizes what is termed standard technique. But for fractures of the shaft of the femur in muscular individuals, the pin or wire is inserted through the lower end of the femur and cast extended up to the groin.

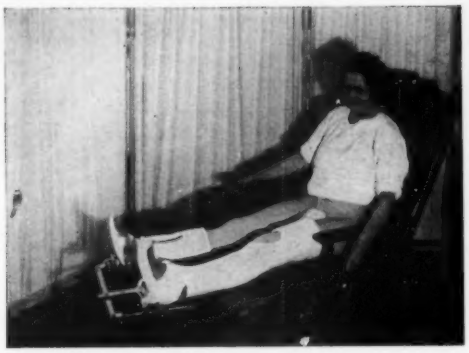

Fig. 4. Mrs. M. M. with a right intertrochanteric fracture was permitted the use of a wheel-chair from the first day.

If we view a typical patient as soon as returned to bed, the advantages of this method are readily demonstrated. It is at once apparent that the head of the bed is not lowered in order to gain counter-traction. And the patient under continuous traction is not tied to the bed with ropes and weights, which prohibit movement of the patient. The apparatus can in no way be interfered with by the too solicitous relative; there are no ropes to become

deranged or adhesive to become loosened; a securely incorporated pin assures permanent apposition of the reduced fragments; and the patient can easily be transported to solarium or home without interference with reduction or immobilization. Because of these facts supervision by the physician is so materially lessened that hospitalization is decreased, an economic saving, which we can say permits funds for physiotherapy, so essential in some cases.

The sitting posture with back-rest from the first day with early use of the trapeze improves metabolism and circulation, which is of vital importance. With the wheelchair in use in many cases by the second or third day the feeling of contentment adds to the general well-being, with the result of cheerful cooperation of the patient. No one knows better than the physical therapist that an essential principle of fracture treatment is the correct mental attitude of the patient.

With this method none of the torso is plaster-covered and windows are cut in certain parts of the cast itself. It is always cut out over the dorsum of the foot and over the patella. In fact, if indicated, all or most of the anterior portions of both casts may be safely removed, a few encircling bands only are necessary on the well leg. Massage of the knee-joints, passive flexion of the knee on the injured side and daily movement of the knee-caps prevent adhesions and thus obviate the stiff joint, which invariably results from enforced immobilization. The wide area of the body free to the benefits and comforts of massage also permits exposure to infra-red and high frequency treatments. Better circulation and relaxation of muscular spasm with improved muscle tone, due to physical therapeutic action, are evident in the increased general euphoria.

As health bears a direct relationship to posture, there must be no scoliotic development. At first thought, it might seem as if the upward thrust of one hip with the downward pull on the other would create a pelvic tilt. But as the patient is not hampered in movement, being free to move in any position in bed, he immediately lies in such a plane that the spine is at exact right angles to the transpelvic line, a fact attested to by X-ray examination. Radiographs taken at occasional intervals to check callus formation will also reveal the fact that there is no interference with either reduction or immobilization despite the free movement permitted, for patients may even be turned over when necessary.

The time for removal of the pin varies in the same manner as the period of immobilization; due consideration to age, type of fracture and callus formation. But the precaution against early weight bearing must be strictly observed. A walking-caliper or crutches is advised for a period of six months post-trauma in cases of fractures of the femoral shaft, while a year may be requisite for those of the neck. Should bowing occur due to muscle tension on soft callus, a cast or brace with adequate pressure pads is a simple means for correction. During this period the agents of physical therapy are definitely indicated to assist the patient to help himself to early and full restoration of function.

Many of these fractures occur among the aged, very susceptible to hip fractures, yet they cannot stand treatment in actual confinement else they succumb to pulmonary disorders. By this treatment they are given the requisite movement; cardiac patients are not condemned to suffering since they may sit up with safety. And as for the obese patient, no other method could care for these cases so efficiently.

To conclude, when fractures of the hip or shaft of the femur are treated by the Well-Leg Splint, prognosis is better while increased function is obtained in less time than by other methods. As reduction is carried out under local anaesthesia, shock from the trauma is not increased due to a general anaesthetic. Movement is a prime factor of the patient's convalescence; he sits up in bed, uses a trapeze at will and is moved from the bed at any time. Not only is the body exposed to the benefits of physical therapy but in hip fractures it is not necessary to apply any plaster to the thigh. The comforts and advantage that physical therapists are now able to render with the use of this method is frequently of vital importance, as it is the deciding factor in making a favorable prognosis possible.

A Synopsis of the Treatment of Chronic Arthritis*

By George A. Williamson, M. D.**

The treatment of chronic arthritis is one of the most complex of the problems in modern medicine. "Next to cancer, there is no more pressing medico-social problem than that of arthritis."[1]

The literature on the subject is burdened with glowing accounts of new drugs and the results produced by them. It is only after the physician has tried many of these new discoveries that he realizes how much better it is for him to adhere more closely to a saner routine, as more permanent improvement and actual progress is made by following such a course.

It is not intended that this paper will cover at all thoroughly the treatment of arthritis. The more strictly orthopedic aspect will be gone into in some detail and the other phases of treatment merely mentioned.

No time will be spent on the classification of the disease except to state that two forms are recognized. Proliferative arthritis, which is accompanied by such terrible deformities in younger people, and degenerative arthritis, which causes so much discomfort in older individuals, are to be considered.

In both types of arthritis, the treatment must be initiated by a thorough examination of the patient. Focal infection in teeth, tonsils, sinuses, prostate, and bowel are carefully searched for and, if found, are eliminated as thoroughly as possible.

Postural defects or other indications of faulty

*Read before the annual meeting of the Minnesota State Medical Association, Duluth, Minn., July 16, 1930. Also appeared in Minnesota Medicine.

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body mechanics should be remedied by the use of supports and supervised exercise.

The abnormally low basal metabolic rate present in 39 per cent of cases, according to Swain and Spear,[2] is treated with Lugol's solution or thyroid substance, and the lessened sugar tolerance found by Pemberton and others,[3] is favored by the administration of a low carbohydrate diet.[4]

The various drugs in use are too numerous to mention. It is found that sodium salicylate gives the maximum relief from pain and is not at all harmful. As there is no specific against the disease, the use of any harmless substance giving comfort to the patient is often all one has at his disposal.

Heat is a boon to all arthritics[5] and the method of administration not of the greatest importance. Best results have been obtained by the use of cabinets, or electric cradle baths, which, by their diaphoretic action, assist the general elimination. Local heat to the affected joints by the use of the electric baker, infra-red lamp, or diathermy helps to relieve the pain and diminish the swelling. A baker is very simple to construct and its usefulness unquestioned. As much heat as the sufferer requires is at all times available.

One other very important measure which must be emphasized is the use of foreign protein reaction produced by the intravenous administration of triple typhoid vaccine as suggested by Miller and Lusk, Albumose (Merck's) suggested by Kolmer,[6] Coley's Fluid,[7] and others. Very beneficial results have been obtained in cases which show signs of activity in the joints. The pain is quickly relieved, swelling in the joints subsides, and general improvement results in a definite percentage of cases. The method of administration is very simple. Beginning with 0.5 cm. of triple typhoid vaccine (Minn. State Board of Health) intravenously, the doses are gradually increased 0.5 min. at a time, until 2 min. are given. Doses are given five days apart and in courses of five or six. The patient should be kept under observation, as the reactions are sometimes very severe.

Turning now to the more strictly surgical aspects of the disease, the thought of deformities immediately presents itself. Can these deformities be prevented and what can be done with them when they do occur? "We cannot prevent all deformities but we can prevent most of them," is a statement made by Pemberton.

The question of the prevention of deformities is one of prime importance, particularly to men in general practice. One of the great pleas made by all orthopedic surgeons is made to the general practitioner, begging him to apply splints of some kind to every patient who is confined to bed because of any illness affecting his locomotor system. Much of our work in the treatment of arthritis, infantile paralysis and tuberculosis is the correction of deformities which could have been, to a great extent, prevented.

In the acute onset or in acute exacerbations of the chronic disease, pain is present in the joints on the slightest motion. The muscles, by going into spasm, attempt to relieve the pain by holding the joints immobilized. The powerful flexor muscles hold extremities in flexed positions and if these positions are allowed to persist, deforming contractures result. It is essential in joint disease to be aware of the possibility of ankylosis and, if this condition is to develop, to hold the joints in the position of optimum function.

May we consider first of all the splints available. Plaster of Paris, because of its great adaptability, probably ranks highest, with sheet metal splints, aluminum splints, and padded wooden boxes next in order. For the spine, a bed with two mattresses and boards between them and the springs to prevent sagging, is always available to everyone. Bradford frames and plaster beds are probably the most ideal. A leather and steel back brace of the Taylor type can be furnished for ambulatory treatment.

A knowledge of the optimum position for function is very essential. For the shoulder the position is one of 75° abduction and 15° of forward flexion with the palm of the hand directed toward the face. If one elbow is involved it should be held at a right angle in the case of a man, and below this point if the patient is a woman. If both elbows are involved one should be held below and the other above a right angle. The wrist should be held in the more powerful grasping position, slightly hyper-extended. The hip is best if it is held abducted, externally rotated, and flexed a few degrees, while the knee is best if held flexed 5 to 10°.

At this point a word of warning must be injected. The too prolonged fixation of joints is very harmful, as ankylosis will surely follow, whereas it might not have developed if motion had been started earlier. With the subsidence of pain and tenderness, the joints should be baked and moved gently both actively and passively. The efforts of the patient to move the extremities benefits both the joints and atrophied muscles. Pump-handling stiffened joints does much harm by producing denser adhesions in response to the vicious irritation.

Synovectomy and removal of loose bodies: Thickening of the synovial membrane with formation of villous processes which project into the joint spaces is frequently found in chronic arthritis. Frequent pinching of these villous processes in movements of the joints results in repeated attacks of joint pain, synovial swelling and effusion. Synovial tags, osteophytes, or fragments of joint cartilage may become detached. These loose bodies are a constant source of annoyance by causing repeated catches or locking of the joint. Synovial swelling and effusion usually follow when these bodies become pinched. Swett, 8, 9, 10, 11, 12 states that removal of the synovial membrane from a diseased joint has a three-fold purpose: (1) it removes joint exudate which would not absorb by the usual channels; (2) it removes infected tissue which may be considered as a secondary focus of infection prolonging the disease; (3) it allows improvement in the general metabolism because of the early resumption of active exercise.

Excition of these fringes, as much of the synovial membrane and as many osteophytes as can be reached, or removal of loose bodies, is accompanied by marked relief. A careful and thorough synovectomy is followed by a short period of rest until healing has taken place before vigorous physical therapy is instituted. The physical therapy referred to is chiefly active motion of the joint by the patient's own efforts but not to the extent of producing irritative symptoms. Early resumption of exercise after synovectomy results in general improvements in body metabolism, muscle tone, and physical comfort.

A patient who is willing to cooperate in the

treatment of his disease need have no fear of a stiff joint following either of the above mentioned operations. J. Albert Key[13] has shown that there is replacement of the synovial membrane by a tissue of fibroblastic origin which takes on the function of the synovium.

If motion is present in a joint to such an extent as to be of definite functional value every effort must be made to preserve it. Frequently, due to the presence of a moderate flexion contracture, the motion present cannot be utilized. An example may be cited in the case of contracture of the knee joint. Frequently the joint is flexed so that weight bearing is impossible, but there may be good available motion inside the angle of flexure. If the limb can be put in a position of good function and at the same time preserve the motion present, an excellent result will be obtained.

Frequently a joint stiffened by intra- or extra-articular fibrous adhesions retains a few degrees of motion. In this case the correction can be obtained through the joint itself. The method of widest acceptance is that of gradually stretching the contractures by the use of adjustable splints or plaster of Paris wedging dressings. Either of these measures may be preceded by tenotomy of the contracted tendons causing the deformity. A carefully fitted, well padded plaster of Paris dressing may be applied to the extremity in the deformed position. A transverse cut is made through the full thickness of the plaster opposite the affected joint line on the side of the concavity. By insinuating wooden blocks of increasing thickness the flexion of the joint is gradually overcome as the gap in the plaster increases. Undoubtedly this is a method which is available to every practitioner. Splints of the adjustable type are very efficient but require careful observation and repeated adjustments as the deformities are overcome.

Silver[14] has shown very conclusively that the joint capsules play a large part in the maintenance of deformities. The denseness of the scar formation in these tissues practically prohibits correction of contractures, and if forcible means are used the result is often a subluxation of the joint. By dividing the capsule on the side of flexion, contractures can be corrected completely, or nearly so, at once. The limbs are held for a short time in plaster of Paris and then immobilization is followed by use of physical therapy directed toward active and passive motion. A warning must be issued against the complete correction of contractures if, by so doing, the vessels and nerves in the area would be put under too much tension. The reason for the warning and the results which would follow are obvious.

Forcible manipulation of joints to correct contractures must be mentioned, but this method is not a safe one except in the hands of an expert.

A few degrees of motion in a diseased joint is very seldom of any functional benefit and only too often it is a cause of disability because of the accompanying pain. The problem of treatment in these cases is difficult. One must decide whether a firmly ankylosed joint in good functional position is more advantageous to the patient than a joint upon which an operation for the production of more motion has been attempted. It must be remembered that many of the arthroplastic and similar operations are followed by a recurrence of ankylosis. From the economic standpoint, the early ankylosis of the joint may be to the patient's benefit.

The operations designed to produce complete ankylosis in the joints are all fairly satisfactory. Probably the best procedure is the intra-articular fusion of arthrodesis. Extra-articular fusion may be obtained by a similar type of operation and as the joint is not opened the shock is not so severe. Fixation in plaster of Paris is maintained after operation until ankylosis has been obtained.

As regards the correction of deformities in joints which are completely ankylosed, much can be said. The methods to be used depend upon whether a movable joint, or a fixed joint in good functioning position, is to be the object attained. Osteotomies of the linear or cuneiform types allow the bones entering into the ankylosed joints to be placed in the desired position. Plaster of Paris dressings are applied to maintain the extremity in this position until union takes place. In many cases this is the most desirable procedure as it gives freedom from pain, an extremity in good position for function, and an earlier return to work than is obtained in the other type of operation. The joints, however, remain firmly ankylosed.

Many operations have been described for the production of motion in ankylosed joints. A discussion of the various methods with evaluation of end-results is too big a subject to be considered at this time. There are a few general considerations which could be mentioned. If both hips are ankylosed an arthroplasty of at least one of the hips should be attempted. If this is successful the opposite hip may be operated upon at a later date. If the hip and knee of one extremity are ankylosed, an attempt to obtain functional motion in the hip should be made. The ankylosed knee would probably not be enough of a disability to make arthroplasty on this joint necessary if motion is obtained in the hip.

This brief summary would not be complete without at least mentioning some of the most recent work upon the problem. Reference is here made to the sympathetic ganglionectomy[15] introduced by Rowntree and Adson[16] in 1927. The work is highly experimental and remote results have not been observed. Changes in the extremities are chiefly due to the increased blood supply following the abolition of the vasomotor influence on the blood-vessels. Skin surfaces change from the cold, clammy, waxy appearance found in chronic proliferative arthritis to the warm, dry, ruddy complexion of normal skin. Joint pain and joint effusion subside, probably due to the improved circulation. One of the questions which must be decided, however, before much enthusiasm is developed, is the ultimate outcome of the joints themselves. Can we expect to interfere radically with the sympathetic supply to blood-vessels, joints, and other soft parts without producing unfortunate end-results? What are the possibilities of the development of neuropathic joint disease like that found in tabes dorsalis, syringomyelia, and other similar conditions? Is the relief from pain, the comfortable warmth, and decreased swelling a permanent change or is it just a temporary one? It is felt that in carefully selected cases the procedure is worth trying and that efficient after-care and observation will bring many hopeful facts to light.

The treatment of arthritis may be summarized briefly:

1. The persistent search for foci of infection and metabolic and static disorders, and their correction.

2. Improvement of general health by supervised rest, diet, heliotherapy, etc.
3. Alleviation of pain in recently infected joints with local heat, and properly controlled fixation in splints and in the chronically inflamed joints by mechanical or operative fixation.
4. Relief of pain and swelling with increase of motion in the joints by the use of triple typhoid vaccine to produce foreign protein reaction.
5. Restoration of motion when possible, by active and passive exercise or by operative means.
6. The correction of deformities.
7. Sympathetic ganglionectomy in properly selected cases.

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History, Development, and Purpose of Occupational Therapy*

Jane Myers, O. T. Reg.

The desirability of occupation as a pastime to relieve monotony of a home or hospital routine, or to render institutional patients more tractable through regular expenditure of energy in work has been demonstrated in practice for a century and more.

Occupational Therapy is not, as is so frequently thought, a new form of treatment. It is one of the oldest forms. The Egyptians in 200 B. C. recognized the value of occupation for the mentally ill, and employed it. Aeschlapiades, a Greek pioneer in the humane treatment of the insane, used occupation, wine, and light as treatment instead of dungeons and chains in 125 B. C. In 172 A. D. Galen wrote, "Employment is nature's best physician and is essential to human happiness."

As early as 1791 Phillippe Pinel in France, Samuel Tuke of the York retreat in England, and Rush in Philadelphia, all used this treatment for mental patients. In 1822 at McLean Hospital, the first of its kind in Massachusetts, Dr. Wyman instituted occupations and games for patients as means of diverting wrong association of ideas and inducing correct habits of thinking and acting. This hospital, now a part of Massachusetts General Hospital, was the first to engage a full time therapist. Today, this department is a very active organization and wonderful work is being carried on.

For the next fifty years little advancement was made in this form of treatment. Sheppard and Enoch Pratt Hospital of Baltimore in 1895 started to interest patients in crafts and in 1905 a teacher in Arts and Crafts was employed. A year later Susan Tracy, a nurse, gave a course in invalid occupations at the Adams Nervine and in 1911 gave a similar course in the Massachusetts General Hospital.

In 1903 Dr. Hall established Deveraux Mansion for the neuro-psychiatric cases. In 1914, Dr. Goldthwaite joined him and Orthopedic cases were admitted.

It was during and since the war that the real scientific application of occupational therapy became operative. At the request of the Surgeon General the Boston School of Occupational Therapy was opened in 1918 as an emergency measure. In 1919 it was reorganized for training occupational therapists for civilian work. Other schools were then organized and authorized by the American Occupational Therapy Organization.

The war gave great impetus to the work and we have experienced first in one phase of medicine and then in another the using of occupational therapy as a curative measure under prescribed treatment methods. In the last few years several institutions for the aged and infirm have added a professional therapist to the staff, not just as some one to keep these indigent people entertained, but to give treatment which has been recognized these many years as a necessary adjunct to the care of mental patients. Why should it not be just as necessary as a preventive measure for those who, though mentally stable, are in physical situations that might produce mental instability?

The professional definition of occupational therapy is: "Any activity, mental or physical, definitely prescribed and guided for the distinct purpose of contributing to or hastening recovery from disease or injury." Note the broadness of this. Any activity, mental or physical, may be plowing a field, studying foreign language, playing baseball, or working at any of the many handicrafts, with this limitation, that the activity be prescribed and guided for the therapeutic value of the patient.

Occupational therapy involves a program of treatment, a progressive program in which occupation, physical treatment, to rebuild or re-educate the patient, mentally, physically, and socially, according to the individual need and to his highest capability.

This program of treatment is four-fold: In each you can easily select the influence it will have on the aged man or woman.

Mentally:

Arouses and develops attention.
Creates new interest.
Gives an opportunity for self-expression.
Eases emotional strain.
Gives an outlet for repressed energy.
Substitutes encouragement for discouragement.
Replaces unhealthy mental trends for healthy ones.

*Read in the Training Course for Volunteers of the Dallas Junior League, which sponsors the Occupational Therapy Department in the Texas Scottish Rite Hospital for Crippled Children, Dallas, Texas.

Has a normalizing influence. It is natural for men to be occupied.

Occupational therapy is based on the mental mechanism whereby but one idea can occupy the focus of attention at a given time.

Physically:

Restores functions to disabled joints.
Renews wasted nerve and muscle tissue.
Increases blood supply and healing processes.
Builds up resistance to fatigue.
Develops mental and physical co-ordination.

Socially:

Raises morale of patient, ward, hospital and home.
Develops group responsibility and cooperation.

Gives opportunity for social contacts in normal activities. There may be need for all three: mental, physical and social re-education. Emotional stress reacts on functional activities of the body. Physical injuries bring depression, mental fatigue, inertia, which develop unsound attitudes and actions. A treatment in any of these three fields should react favorably in the other two. No cure is complete until readjustment is reached in each one.

And the fourth dimension of the program is:

Economically:

Occupational therapy is of value to a hospital.
Shortens period of stay of curable patients.
Retards deterioration of the extended treatment case.
Raises the patient who is a liability to a useful member of social life.
Lessens laundry and destruction of clothing in mental hospitals.

Economic value to the community:

Fits a man or woman to take up a job when he leaves the hospital, for a long period of idleness during convalescence is not conducive to efficiency.

Assists in overcoming or adjusting physical handicaps to the end of pursuing some profitable occupation.

Gives the child, who unless given treatment now will be a charity charge for life, an opportunity to continue education or train in some work in which his physical condition will not be a deterrent.

Occupational therapy is no longer in the trial or experimental stage. It is an adjunct to medicine and a recognized treatment for the sick and handicapped. As such, it can be administered only by or under the supervision of a trained worker—one who has during her training achieved a knowledge of anatomy, kinesiology, psychology and hospital ethics, and is able to carry out the doctor's prescription with a professional understanding.

Occupational therapy being a remedial treatment for disease or injury, it is imperative that it be definitely prescribed and guided by the attending physician, just as any other form of treatment. We must never allow doctors or institutional personnel to feel we are merely amusing unfortunate sick people. We should never lose sight of the diversional aspect of occupational therapy because we feel the cases where our efforts are employed in preventing fatigue and exhaustion by relieving the causes of restlessness and irritability are just as therapeutic as the orthopedic cases wherein we can actually help develop muscle strength and motion in the joints.

The application of occupational therapy requires a complete knowledge of the individual case, his social history, his mental status, and most of all, the character and extent of his disability.

For successful practice of occupational therapy, very close cooperation with the doctor is essential. The therapist needs all his helpful suggestions as well as precautions. The doctor's knowledge and judgment regarding the patient is the only real foundation on which she can build her program of progression.

Standard and complete records must be insisted upon. Any piece of work that is worthy of our efforts should be carefully recorded if we are to progress and improve, profiting by our experiences and sometimes, mistakes. It is imperative that we use daily, monthly, and annual records and reports. How else is it possible to measure our improvement or, if necessary, check our failures? A trained director wants to watch the progress of her patients and only by means of definite and complete records is she able to show what results have been obtained in her work. To be able to point out to hospitals or social organization authorities that we have treated so many more patients this month than last or to lay before the doctor a well kept progress sheet on a specific type of patient with the reaction to treatment is often very essential. These records are a permanent file of our work and will gain for your League a definite satisfaction in its service, and respect and admiration for the department.

If occupational therapy is to be a definite treatment, then it must be administered, whether it rains, whether there is an interesting sport event or lecture or whether there was a big party the night before. If the volunteer is to have a definite part in assisting in these treatments, the professional worker must feel confident that she can rely upon the one whose duty it is to be there that day to be there or have someone there in her place. The league which uses its volunteers as active workers in its main project shows the most successful results. The volunteer in order to be helpful must have sufficient knowledge and training in her work to be able to take her place in the atmosphere of the professional worker in the hospital. It is our hope that this course we are launched upon will fill this need of the volunteer.

The psychology of the crippled child is just the same as the psychology of the normal child. The nearer normal you can make a child feel, the better. One of the clearest lessons I learned in my academic training came on a visit to the Elias Michael School for Crippled Children in St. Louis. The superintendent made this statement: "Our first and hardest problem is to socialize the child." He went on to explain that these children come from homes where, because they are handicapped, some one must be on call to serve them whether for physical needs or mere entertainment. Then, when they are brought into a group where all are handicapped, they have to become accustomed to do all they are physically capable of doing for themselves. I remember he showed us two boys who appeared to be pale. Several weeks before that time these boys had been very difficult and particularly antagonistic to each other. One day they were given padded gloves and allowed to fight it out. One was in a wheel chair and the other had a paralyzed left arm. Who won? That made no difference; the difference came in their attitude to all their contacts. Later we watched a ball game and no odds were given to the wheel chair, the crutches, etc.

So the attitude of the volunteer to the child should be as nearly normal as possible. Assist him in all ways necessary, but avoid doing for him what

he should be doing for himself. The diagnosis of the patient's illness should never be discussed with or before him. This information the professional worker will gladly discuss with the volunteer before or after the treatment. For first contacts, discussion of home, school or pets could be used. The very interests that a group of volunteers brings from the outside world to a handicapped child contributes much to the child's good and enjoyment.

The volunteer's compensation and satisfaction comes through the regular service which she gives, through the actual contact with the children and the realization that her assistance and efforts in the routine duties releases the professional worker to carry on the application of strictly therapeutic treatments. No other service can better supply an earnest volunteer with the joy and satisfaction of service as can work with children. For the artistic nature, volunteer occupational therapy furnishes an outlet for talents and ability; for the scientific or technical mind, an opportunity for expression through working with orthopedic cases that require mechanical skill and genius to devise ways of helping the crippled child regain strength of muscle and increased motion of joints. In the hospital occupational therapy department, a place can be found for any temperament or talent. When properly trained and always guided by the professional worker, the volunteer finds herself a valuable part of the organization. No one has a keener appreciation than a professional worker of the value of the fine spirit of service and boundless enthusiasm given by a group of dependable volunteers.

The National Association has formulated a number of principles and rules for guidance in occupational therapy. They are as follows:

1. Occupational therapy is a method of treatment of the sick or injured or aged by means of purposeful occupation.
2. The objects sought are to arouse interest, courage and confidence, to exercise mind and body in healthy activity, to overcome disability, and to re-establish capacity for industrial and social usefulness.
3. In applying occupational therapy, system and precision are as important as in other forms of treatment.
4. The treatment should be prescribed and administered under constant medical advice and supervision, and correlated with the other treatment of the patient.
5. The treatment should, in each case, be specifically directed to the individual needs.
6. Though some patients do best alone, employment in groups is usually the stimulating influence of example and comment.
7. The occupation selected should be within the patient's estimated interest and capability.
8. As the patient's strength and capability increase, the type and extent of occupation should be regulated and graded accordingly.
9. The only reliable measure of the treatment is the effect on the patient.
10. Inferior workmanship or employment in an occupation which would be trivial for the healthy may be attended by the greatest benefit to the sick or injured, but standards worthy of entirely normal persons must be maintained for proper mental stimulation.
11. The production of a well-made, useful and attractive article or the accomplishment of a useful task requires healthy exercise of mind and body, gives the greatest satisfaction, and thus produces the most beneficial effects.
12. Novelty, variety, individuality and utility of the product enhances the value of an occupation as a treatment measure.
13. Quality, quantity and salability of the products may prove beneficial by satisfying and stimulating the patient, but should never be permitted to obscure the main purpose.
14. Good craftsmanship and ability to instruct are essential qualifications in the occupational therapist; while understanding, sincere interest in the patient and an optimistic, cheerful outlook and manner are equally essential.

The Relationship of Occupational Therapy to Physical Therapy*

Winifred G. Moore, R. N.

Physical therapy is the treatment of disease by physical or external means, as light, heat, massage, water, electricity and exercise. All of these mediums have their place in the treatment of the children we care for in this, and in any crippled children's hospital.

1. They may precede surgery as an attempt to obtain the maximum amount of function, or to develop greater strength in the more responsive muscles which may later be transplanted so as to act to better advantage.

2. Most orthopedic surgical measures are followed up with physical therapy to re-establish retarded circulation and muscle tone, to regain motion in joints, to re-educate paralyzed muscles, and especially to train and accustom transplanted muscles to perform their new tasks.

3. Where no surgery is required, physical therapy and occupational therapy are of great value, their object being to restore the greatest possible amount of function, or to make the patient free of brace-wearing by muscle re-education. The ultimate aim of all crippled children's institutions is to make of these children self-supporting and self-respecting citizens through a rigid program of functional correction and rehabilitation.

As with occupational therapy, physical treatment is ordered by the attending physician and carried out only as written on the special order form. Records are kept of all orders, treatments given, and the progress made by the patient. This is important not only as it concerns the individual case, but

*Read in the Training Course for Volunteers of the Dallas Junior League, which sponsors the Occupational Therapy Department in the Texas Scottish Rite Hospital for Crippled Children, Dallas, Texas.

as a record and proof of the value of physical therapy or occupational therapy to medicine and surgery.

For one not familiar with the workings of a physical therapy department, an example of an average case may be cited:

Heat by radiant lamp or infra-red is almost always prescribed and precedes the other treatments. This increases the superficial circulation of the part, as is seen by the redness of the skin after a few minutes exposure. The next thing is to assist the extra blood on its course back to the heart and also to stimulate the deeper circulation and motor nerves with massage. Medical electricity has its place here, faradic current for nerve stimulation and inhibition of contractions in paralyzed muscles, and diathermy for causing heat in the deeper tissues. The physical therapist in orthopedic hospitals finds that a thorough knowledge of musculature, and an understanding of muscle re-education are perhaps paramount in importance. Here we try to teach the patient to contract weak muscles to the fullest amount of contraction possible, even though no movement is made, slowly and rhythmically to count. We must be aware of fatigue symptoms as slowing up or incompleteness of action. Often apparently paralyzed groups show power after two or three days of unresponsive attempts. This is sometimes explained by the fact that a child has to learn to contract a long unused muscle. If there is considerable weakness of muscles, there should be a definite period of rest between the exercise in the two departments. The danger of over-fatigue can not be stressed too much. On the other hand a stiffened joint may, with advantage, go direct from the heating and relaxing effect of the physical therapy treatment to the work in occupational therapy.

In the mobilizing of stiff joints or re-education of paralyzed and transplanted muscles lies the strongest link between these two therapies. To quote briefly some of the points brought out in last week's lecture on occupational therapy:

1. Restores function to disabled joints.
2. Renews wasted nerve and muscle tissue.
3. Increases blood supply and healing processes.
4. Builds up resistance to fatigue.
5. Develops mental and physical coordination

would be a very apt description of some of the effects of physical therapy with regard to orthopedic work, and emphasizes our point.

Of considerable interest to the class was a brief demonstration following the above.

First case: Transplant of long head of triceps to acromium, and trapezius to humerus with fascia from the thigh. A brief muscle training demonstration was followed by basketry done with the arm suspended in abduction.

Second case: Old fracture in elbow with limitation of motion. Operation: Division of anterior, medial and lateral capsule. Division of part of biceps and major part of brachialis. Active extension, flexion and supination to fullest extent of motion was shown and then the work of weaving gave a good example of the correlation of these two departments in our hospital.

The Fate of the Birth Injured

By Theodore A. Bretscher, Ph. D.*

Among the various forms of physical handicaps is that affliction which, neurologists tell us, is caused by an injury of certain areas in the brain at birth. A very small hemorrhage in the brain may damage the brain to such an extent that the child is incapacitated for life. Since this injury is usually received during or at the time of birth, the condition is generally referred to as intracranial birth injury. In the general class of the so-called Birth Injured, which comprises a large variety of mental as well as physical abnormalities, we find certain types of individuals who are sometimes called spastics. The term "spastic" is really not an appropriate name for this condition but it is the best we have now in our popular terminology.

One peculiar characteristic of the so-called spastic or Birth Injured is that any exertion of voluntary effort, through which the normal person acquires his conventional modality of muscular adjustments, tends to defeat the very end desired. When attention is focused upon the act to be performed, the patient is unable to perform the act successfully. To tell this patient to do a certain thing seems to release an uncontrollable over-flow of impulses into the muscles, which makes the individual unable to carry out the suggestions.

This difficulty of carrying out a suggestion does not lie in any lack of comprehension. The patient readily understands and perfectly appreciates the idea conveyed to him. Paradoxical as it may seem from the point of view of the normal, the very fact that the patient fully comprehends the significance of the suggestion, results frequently in the physical inability to carry it out. Attention or focalization on the act to be performed usually upsets the entire neural and muscular equilibrium of the patient.

In certain cases the patient is able to perform the required movements for adjustment with relative ease. He may be able to manipulate a pencil or typewriter in a fairly efficient manner, as long as the attention is focused, not upon the act of typing, but upon the material to be typed. In most cases the individual is unable to perform any movement which requires fine muscular coordination. For instance, you may have a case where the afflicted individual is unable to bring a glass of water to his mouth without spilling the water. The effectiveness of any form of muscular coordination is literally clogged by an over-concentration of nervous energy directed to one center. Hence the patient becomes very apprehensive and this adds further to his inability to gain his desired end. He becomes unduly self-conscious, particularly in social situations. The more he tries to dam the avalanche reaction, the worse the situation becomes. The emotional experience is similar to that of stage-fright, which most of us have probably gone through;—but with this difference; that while in the normal the outer manifestations are rather negligible, in the spastic there is a contortion of the entire muscular apparatus. Such an individual feels himself a public display and continually suffers the psychological experience of stage-fright.

*New York.

Every emotional experience, particularly of anger and fear, exerts such a profound influence upon the muscular coordination that any focalized attempt on the part of the patient to gain control only aggravates the condition. The neural and muscular mechanism of such an individual might be compared to a too-highly geared machine which reacts violently upon the least provocation.

Two important points seem to be worthy of particular emphasis. First, the excessive over-flow of nerve impulses causes the patient to acquire certain peculiar, unconventional ways of behavior. These unconventional modes of behavior, in turn, result in a sort of estrangement between himself and his social environment. His own comrades, as well as strangers, do not quite know how to classify him. His muscular contortions, such as grimaces and drooling, result in an uncomfortable attitude on the part of his associates as well as of strangers. In trying to assist him in the performance of an act, his companions tend but to make him more self-conscious, and his heightened sensitivity, in turn, makes them nervous and less able to help him, thereby creating a very unpleasant situation for all concerned. The patient's inability to gain voluntary control over his erratic movements which frustrate his efforts, results in a fear of performing those particular movements. Hence he will shun every situation in which such movements are required. He has never learned to acquire the ease and poise with which the normal performs his daily routine.

In the case of general or local paralysis, or the loss of limb, there is a privation of function, and the problem then is either to restore the lost function, or to train some other member of the body to take it over. In the case of the Birth Injured, the problem is quite different. Here is is not a question of restoring conventional modality of coordination, but rather of training the patient in the proper use of certain muscles which he has never really learned to use, or which he has, through excessive reaction, used wrongly.

The possibility of helping the patient to bring about more useful coordination and movements depends upon the nature and the degree of each particular case. Whether the individual will be able to acquire the conventional modality of expression will depend upon various factors, such as the degree of spasticity, age, training, etc. The point to be kept in mind is that these patients have never learned to perform even habitual acts with normal ease. The primary aim in the re-education of these people is to get them to relax.** Hence, the training is first directed toward giving the patient such exercises as will minimize his general muscular rigidity.

Through this procedure the patient gradually learns to gain such control of muscle groups as will serve him to act with some degree of ease. In this way he will eventually be able to dissociate the emotional factor from the muscular act, thereby eliminating the barrier of estrangement and unconventionality existing between him and his social environment. He will learn to understand himself and his own limitations and possibilities; and with this appreciation, and the acquisition of more efficient coordination, a new world will open up to him.

The psychological attitude on the part of the patient is, of course, of tremendous importance. Unable to do things in a customary way, he is prone to become morbid or skeptical. His salvation, he is told, lies in learning to let go of himself and relax; but at the same time he is requested to make new efforts of re-adjustment. What is the meaning of this paradoxical request? The answer lies in the peculiar nature of the condition itself, which might be called the *"fate of the over-flow."* The fate of the patient depends upon the utilization of the over-flow of excessive nerve impulses. Either it is directed and utilized through proper training, in such a way as will serve him in finding a happy place in the social order, or else he is destined to remain an unhappy stranger to himself as well as to society. Muscular training is only the beginning of diverting this superfluous energy into successful movements. What the patient will be able to do with his excessive energy in the way of creating for himself a philosophy of life, and of discovering a mode of behavior which would lead to the realization of this philosophy, will depend upon his mental endowment, his moral character, and the opportunity which society is willing to give him.

Editor's note—The writer of this article is himself afflicted with the thing of which he writes. Seldom do we have the opportunity of getting behind the scenes in this scientific manner.

**For a further discussion on the problem of relaxation from the psychological point of view see "THE ROLE OF IMAGERY IN CONNECTION WITH THE TRAINING IN RELAXATION." *Physiotherapy Review;* Sept.-Oct. 1933.

Principles of Treatment of Chronic Non-Specific Arthritis

By Wallace Duncan, M. D.*

The realization that no single agent can be looked upon as the cause of so-called chronic rheumatism renders imperative an open-minded attitude toward the approach of patients with this disease. In many instances, no specific factor has been found upon which to place responsibility and this has resulted in a general and unwarranted attitude of pessimism. The failure to consider the joint disease a manifestation of the patient's general physical deficiency has been conducive to unsatisfactory results in treatment. Certainly if as much energy were expended in the investigation of many of these patients in the incipience of their disease as is applied when gross joint destruction with its resultant deformity has occurred, there would be fewer arthritic patients progressing toward the state of partial or complete invalidism. Altogether too little effort and concern have been exercised at that time in the course of the disease when joint changes are negligible and consequently amenable to proper care. It becomes obvious that only with concerted effort and conscientious supervision at this stage can the most desirable results be obtained, with the consequent change in attitude of the public and profession from one of relative futility to one of comparative optimism.

It is illogical to anticipate improvement in the condition of most of these patients if they are permitted to continue with their daily activities, with the cumulative effects of fatigue and injury to the

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joints. The necessity for adequate rest, particularly among those who have atrophic changes, cannot be too vigorously stressed.

From a pathologic standpoint these patients fall, in general, into one or the other of two groups; the proliferative (atrophic) or the degenerative (hypertrophic). Each of us is familiar with the appearance of the thin, visceroptotic woman in her twenties or thirties who is below par physically in that she is readily fatigued and wakens with the realization that a night's sleep has not helped to relieve her feeling of exhaustion. She is, in many instances, obstinately constipated and takes laxatives habitually. Her hands and feet are always cold and on occasion she suffers from vague pains at various sites. Many persons in this group have never felt well and after a period of continued physical effort, with consequent fatigue, or following some intercurrent infection, or with the resumption of duties in the home after a pregnancy, the more gross signs of joint disease become apparent. The wrists and knees and joints of the hands acquire the fusiform thickening so characteristic of this disease and the rheumatic process is established. It is at this stage that the patient and her relatives become apprehensive.

By well-planned methods of approach these patients in many instances can be rehabilitated; but only by an intelligent appreciation of the patient's general physical state can the most desirable results be anticipated. The eradication of foci of infection as a specific treatment has been brought into a state of disrepute, in many instances because of failure to realize that in a patient already beyond the point of carrying out ordinary duties, the physical state is being depressed further. Haphazard therapy such as this is to be decried, despite the fact that all of us have seen in certain instances dramatic results from focal removal.

Patients of this type should, if possible, be hospitalized with a view to adequate investigation and not merely to lie in bed. Each one should have thorough study for foci of infection, including, in addition to the nose and throat, teeth, bowels and gastrointestinal tract, the pelvis with distinct stress upon the cervix, and in the male the prostate gland. The high incidence of non-specific infections in the latter is in no degree generally appreciated. In many instances, there is a low basal metabolic rate, a pronounced secondary anemia, and in a comparatively large number an absence of free hydrochloric acid on examination of the gastric contents. The colon is frequently atonic and redundant. The peripheral circulation is poor, as a rule. The diet is found often to have been relatively high in carbohydrate and low in the vitamin-rich foods.

The aim should be to improve the patient's general physical state by rest, a diet high in fresh fruits and vegetables, animal protein and fat, and low in carbohydrate; and to this are added in sufficient quantity wheat germ or yeast or other products containing vitamin B, along with cod liver oil or halibut liver oil; the latter is desirable despite the ease of exposure to sunlight, even during the summer months. The removal of foci of infection can be resorted to when the patient's condition warrants it, and should be carried out after due consideration.

Physical therapy intelligently administered is a desirable adjunct to other forms of treatment. Indiscriminate manipulation of joints can be highly detrimental. Breathing exercises, postural correction, and heliotherapy are desirable in the vast majority of these cases. Improvement of the general circulation by heat and general massage, diathermia to selected joints, and paraffin baths for the hands and feet all make their very definite contribution toward the rehabilitation of the patient.

The importance of the prevention of joint deformity by application of splints and traction and supervised exercise for the affected parts cannot be stressed too much.

Medication in the form of neo-arsphenamine intravenously or Fowler's solution or iodine by mouth and iron and dilute hydrochloric acid probably offer more than any other preparation. Colloidal sulphur may be used intravenously and intramuscularly as well. Vaccine therapy is not without its proponents and doubtless has its place in the treatment of this type of individual along with other measures. Nonspecific protein therapy is most beneficial in properly selected cases.

The fact that the hospitalization of many of these patients is an impossibility does not preclude the attempt at as close an approximation as possible to such a regimen. It must be remembered that adequate rest over a sufficiently long period, with approach from many directions is essential to their proper care.

In contrast to these patients are those of middle age, often obese, whose knees and lower back become stiff and who develop Heberden's nodes and have degenerative or hypertrophic polyarthritis. It is in this type of arthritis that infection probably plays little if any part. These joint changes exhibited clinically and radiologically are probably nothing other than a manifestation of a generalized degenerative process with trauma superimposed. Metabolic disturbance unquestionably plays a prominent role as manifested by the gratifying response to reduction of weight, and compensation for endocrine deficiencies by the use of thyroid extract and ovarian and pituitary hormones.

These constitute the essential methods of care, along with the lessening of mechanical strain with its resultant joint irritation. Every patient suffering from an arthritic process not specific in origin should be given the benefit of the doubt so far as the removal of foci is concerned. In these cases, physical therapy has its important place, and as in the preceding group, diathermia, radiant heat, and the paraffin bath are particularly valuable.

In the discussion of so controversial a subject it is futile to attempt to review the merits and the shortcomings of every form of treatment ever proposed. Suffice it to say that in one's experience these measures which have been somewhat sketchily outlined have given gratifying results. Altogether too little stress is placed upon the value of adequate rest, particularly in the case of the patient who has atrophic polyarthritis. Too little thought is given the fact that these patients have a systemic rather than a local disease. There would appear to be no question whatever that the solution of the problem of arthritis lies in the better standardization of treatment, the realization of the necessity for early recognition of the disease, the immediate institution of proper measures, with the end to be sought, the prevention of progression to permanent joint change and consequent grave economic loss.

The Treatment of Compound Fractures

By M. H. Tibbetts, M. D.*

In defining a compound fracture we may say that it differs from the simple fracture by having a break in the skin which communicates with the site of fracture. This path may vary from a tunnel one-half centimeter in diameter to an excavation laying bare the whole length of the injured bone. This communicating opening must be differentiated from a superficial abrasion or laceration of the skin, which does not offer access to the fragmented bone. The abrasion, of course, may offer ingress to the blood stream for pyogenic organisms, which may secondarily involve the bone beneath, but it does not afford a direct contact with the fracture. The directly communicating area is, therefore, that with which we are immediately concerned.

The ends to be attained in a simple fracture are first, the restoration of normal function, and second, the restoration of anatomic appearance insofar as possible. The two are not always easy of accomplishment. In general, the first is by far the more important, whereas from a lay point of view, particularly where litigation is involved, the latter appears to bear more weight. The end to be desired is to attain perfection in both.

In what way does the goal in treating compound fractures differ from that of the simple type? We may answer by adding one more objective to the two already recited and place it in the important rank. The reason for its peak position is that if it is not gained we are no longer dealing with function or anatomic appearance but with the very maintenance of life itself. This first consideration in compound fractures, then, is the prevention of infection, or if infection is already present, its abatement or elimination.

In the presence of a massive laceration, in which there appears to be little to salvage, one is confronted with the question of amputation. Oft times these tremendous tears are worse in appearance than in reality. The prime answer to the question lies in the state of the circulation and innervation. The secondary consideration is how much bone and muscle tissue can be salvaged. A third consideration might be added, in which the occupation and financial status of the patient should be studied. Obviously, a laborer upon whom the welfare of his family depended, would be better off without a finger than to subject him to months of idleness while reconstructive surgery restored a functioning digit. A violinist or stenographer, on the contrary, would want the finger saved.

If the circulation and innervation are adequate to maintain the extremity below the lesion, one proceeds first to eliminate the development of infection; second, to align the fragments in their desired position; and third, to immobilize them until union has occurred.

Thorough debridement, in which all accessible dirt and hopelessly traumatized tissues are removed, should be done. From this point on authorities differ. Some prefer leaving the wound open, filling the gutters with Dakin tubes and washing the wound frequently a la Carrel-Dakin. Others, of whom Orr is the popular leader, lave the wound with iodin and alcohol and hold the edges open with vaseline gauze. A third group attempts a primary suture after debridement. Personally, I think this last is too dangerous; I believe that the wound should be left open. The Carrel-Dakin method is said to give good results in some hands, but in my experience it is so seldom properly done that I feel it should not become a routine procedure. The more I see of Orr's method of non-interference after adequate drainage is attained the more I like the end-results in these cases. Particularly do I dislike any irrigating into blind pockets. It is too apt to carry surface infection deeper and the antiseptic may cause necrosis of tissue, which in turn offers excellent media for new bacterial growth.

Before we advance to a discussion of reducing the fracture and maintaining its position, a word should be said about specific infections like tetanus and gas forming organisms. So long has the bugbear of lockjaw been known and feared that little need be said here pertaining to it. Most men use the antitoxin as a matter of routine. Less familiar is the infection caused by the gas bacillus, but even more spectacular is death from it. It comes swiftly and overwhelmingly. Excellent results have been reported from the prophylactic use of gas bacillus infection serum. This, to be effective, must be given early. All compound fractures that are contaminated with dirt that might harbor the gas forming organisms should have the prophylactic serum as well as tetanus antitoxin.

A consideration of the methods of reduction and immobilization of these fractures in detail would consume too much space, but this is not necessary. A few broad principles should suffice. If a fracture can be reduced and maintained in place by a simple cast and at the same time adequate drainage be assured, there can probably be no better treatment. Next in order is traction and splinting. Traction may be skeletal or by skin. The splint may be metal or plaster, provided the wound has adequate drainage. If internal splinting in the form of plate or wire must be resorted to, this should not be covered with skin or muscle. In fact, I am inclined to believe that either should rarely, if ever, be used by the general surgeon. Foster, in Sherman's clinic in Pittsburgh, has reported some excellent results with Sherman's steel plate, but one must remember that Foster and all of Sherman's group are masters in the use of internal fixation and know more of the indications and contra-indications than the average surgeon. Too often in the hands of the many the internal fixation becomes simply a foreign body promoting more necrosis, which in turn forms food for the devastating army of infection.

This, in brief, then, outlines the care of the compound fracture of some magnitude. The smaller wounds may need little attention other than painting with iodin and covering with sterile gauze. At times, this is not enough, but the small opening needs to be opened widely and become a large open wound.

*Duluth Clinic.

Adequate outlet for imprisoned pus should be the watchword.

SUMMARY

1. Prevent sepsis, if possible, by adequate debridement and complete drainage.

2. Prevent tetanus and gas bacillus infection with appropriate prophylaxis.

3. Reduce the fracture and maintain it in the simplest manner possible. Avoid all unnecessary handling of the wound.

Physical Therapy in Chronic Arthritis

By William H. Goering, M. D.*

During the last few years we have been greatly impressed by the efficacy of physical therapy in the treatment of the chronic arthritic patient. Together with elimination of foci, general medical treatment and proper orthopedic observation, physical therapy is essential to the successful treatment of the disease. The physical therapist is a vital unit in the armamentarium of the physician who treats arthritis and its allied conditions.

From the early or prodromal symptoms of the potential arthritic, we can recognize the value of physical therapeutic measures. The chronic arthritic presents certain features that appear indiscriminately in those in all walks of life and in all types of the human family. Having developed an asthenic state, these predisposed persons, during a varying period of several months or years, complain of chronic fatigue, inanition, and exhaustion after the slightest efforts. Should we examine these people during this stage we would find many of the accompanying symptoms of asthenia, namely: low blood pressure, anemia, loss of weight, poor peripheral circulation, cold, moist, or bluish extremities, and most prominent of all the vascular deficiency. Vasomotor constrictions range from constant blanching of the skin to extreme ischemias with painful fingers and toes. Early evidence of this is noted when driving an automobile, holding a book or some similar activity results in numbness or local pain. Assuming that this impoverishment in the vascular supply does prepare a suitable soil, resulting in a lowering of ordinary resistance, we feel assured that one of the primary principles of treatment should be an aggressive correction of this underlying deficiency.

It is extremely interesting to study the various methods of treatment for these symptoms. With the exception of massage, the use of heat is one of the most valuable in the treatment of arthritis from the standpoint of physical therapy. Many types of heating apparatus have been devised for the purpose of supplying wet or dry heat. In general, however, the underlying purpose is the same with all of these methods.

Generalized hyperemia is obtained by the use of thermal baths with temperature ranging from 105° to 110°. This dilates the superficial capillaries and raises the general temperature of the body and circulating blood, relaxes spasms and relieves pain; it promotes elimination and effects a general increase in body metabolism.

The patient should be instructed as to measures that can be applied at home. This is important, as physical therapeutic treatment will give its best results only if given continuously over a period of considerable time. In the home, the use of hot baths, contrast baths and specific exercises are recommended.

Following the application of heat in its various possible forms, massage should be given, if the disease is in the chronic stage. The chief purpose is to restore muscle tone which has suffered during a prolonged period of disuse. The affected joints themselves are given only very light massage. After the disease has reached a quiescent stage more vigorous treatment may be administered to the joints. Massage should never be given to acutely sore joints; but gentle stroking of the muscle bellies only is advisable.

After the treatment of heat and massage has been given, we recommend the application of a counter-irritant to the skin in order to prolong the effect of the heat as long as possible.

In reviewing our cases of arthritis, we find a record of excellent results from the sane application of physical therapeutics. However, very little success can be obtained by use of any of these measures unless they are used continuously and frequently over a reasonable period of time. It is useless to expect results from a treatment given this week and another a week or more later. It is the persistence and stick-to-itiveness which brings the results.

To the patient who is willing to cooperate, the expense of such treatment as outlined above need not be prohibitive. After a few treatments in the hands of a trained physical therapist, the patient can be taught home methods which will serve to carry on the work, and in a measure, give the desired results.

In conclusion, we wish again to emphasize the futility of haphazard physical therapy; that graduated and regular physical therapy in the hands of the expert is of infinite importance to secure satisfactory results; and that persistent home physical therapy will help to reach the optimum improvement in the patient.

*Tacoma, Washington.

The Treatment of Congenital Torticollis

*A New Adjustable Apparatus for Maintaining Postoperative Correction of Torticollis Deformity**

R. Plato Schwartz, M. D.*, Forrest Young, M. D.*, Mr. Edward A Knight**

Fig. 1. Plaster cuirass maintaining over-correction after operation for wry neck. (Jones & Lovett.)

Operation should be regarded as the beginning of treatment for the correction of deformity. Torticollis or Wry Neck of the congenital type frequently requires division of the sterno-cleido-mastoid muscle. The point of election is generally accepted to be at the sterno-clavicular insertion.

The maintenance of position of over-correction formerly included the immediate postoperative application of plaster, Fig. 1. This method was inexpensive but there are no other advantages to commend its use.

The insecurity of sand bags, Fig. 2, led to the use of special head halters, Fig. 3, for maintaining corrected position for the first ten to fourteen days after operation. This was followed by a brace, Fig. 4, which provided for fixation by inaccurate adjustment with bending irons.

Fig. 2. Adhesive strap for over-correction in bed for torticollis. Postoperative. (Sever.)

Over-correction of a deformity is a fundamental principle of Orthopedic Surgery. Tenotomy of the sterno-mastoid muscle may in a few cases, immediately result in a full range of motion. This includes rotation of the head toward the affected side, together with lateral flexion to the side unaffected. When fully relieved, the patient should be able to voluntarily move the head through full range of motion with equal ease to and from the midline.

Such a result, immediately after operation, is not to be regarded as a frequent occurrence. Apparatus as described herein is contra-indicated in such patients. Invariably the cause and duration of congenital torticollis predisposes to the contracture of structures which, because of their location or function, cannot be cut to give free range of motion. These limitations may be removed by proper post-operative treatment with the apparatus described.

Such treatment consists of that form of fixation which, by virtue of its security and continuous action, serves two purposes:— (1) The head, with respect to level shoulders and the sagittal plane, should be held in a position of rotation of the chin toward the affected sterno-mastoid muscle while the head is flexed toward the opposite shoulder. (2) This position should be retained by a continuously acting force which may be increased as the stretching of contractures permits further correction of the residual deformity.

The special head halter with weights attached adequately meets this requirement during the first seven to ten days after operation. Fig. 3. Neither the Buckminster Brown torticollis brace, Fig. 4, nor the plaster fixation, Fig. 1, do more than hold the position of correction obtained at operation. They both fail to provide that active force so essential during the time fixation is indicated in some cases because of prevailing postoperative limitation in range of motion.

Fig. 4. Buckminster Brown brace for maintaining over-correction after operation for wry neck. (Jones & Lovett.)

Secondary contractures can never be favorably influenced by permanent FIXATION in a position of partial deformity. The division of the sterno-

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**In charge of Orthopedic Shops.

Fig. 3. Head halter with weights to maintain position.

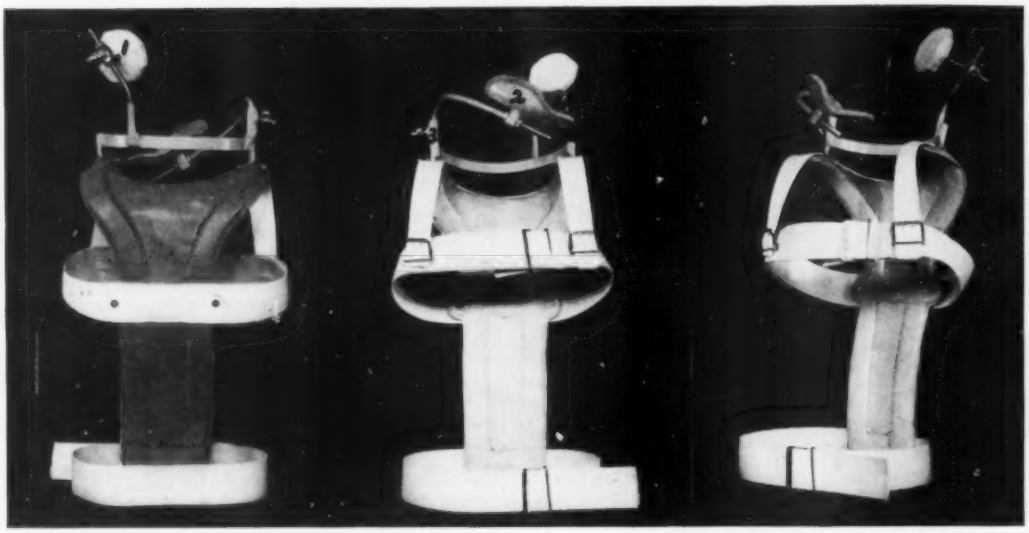

Fig. 5. Adjustable torticollis brace. (1) Occipital pad may be adjusted for height and length. (2) Chin pad may be rotated to follow the head in rotation (3); and may be fixed at required angle at any point along the supporting rod which rotates from support (3).

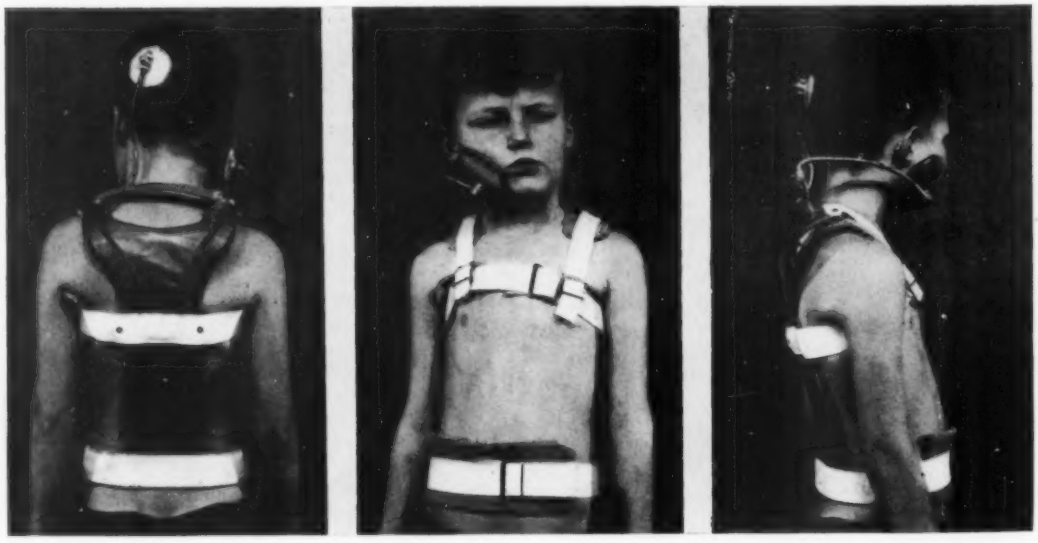

Fig. 6. Adjustable torticollis brace applied to patient.

mastoid muscle should, in most cases, not be followed by FIXATION of the head, unless full range of motion is thus obtained. Mobility of the head is essential for postoperative exercises which favor the strengthening of muscles weakened by prolonged stretching. It is indicated, therefore, that any

mechanism applied for postoperative immobilization should be adjustable.

The adjustments must be possible in the combination of lateral flexion and rotation of the head referred to above. Such adjustments should be made with ease and assurance of security of each new position until evidence of deformity is removed by a full range of motion on the affected side. Three views of an adjustable torticollis brace are shown in Fig. 5. The occipital pad (1), once placed at the proper height, may be adjusted to the precise angle on its support. It may also be made to exert the required lateral flexion of the head by gradually increasing the distance between the pad and its support. Rotation of the head is gained by pressure applied to the opposite side of the chin. The chin pad (2) is made to rotate from its axis (3); it is also made to conform to the increasing distance between chin and shoulder by changing its position toward the end of its support and, therefore, a full correction of the deformity is obtained. The illlustration, Fig. 6, clearly reveals the method of securing the brace to the body.

SUMMARY

In certain cases of congenital torticollis division of the sterno-mastoid muscle fails to fully correct the deformity.

FIXATION of the head in such a position of partial correction fails to provide for the most correction.

In these cases it is desirable and possible to overcome prevailing contractures during postoperative treatment.

One should, therefore, regard operation as the beginning of treatment in these patients.

An adjustable torticollis brace has been described. By the use of such methods contractures not relieved by operation may be greatly relieved if not entirely corrected.

A Discussion of Body Mechanics*

By Joe B. Foster, M. D.**

It is difficult for me to express my appreciation for the very great honor which you have conferred upon me. You have selected a subject for me which is very near and dear to me and a subject that I feel has been neglected to a very great extent by the medical profession as a whole. Among my own colleagues there are many who minimize the importance that a perfectly working machine bears to normal health and efficiency.

I want to take this time at this particular place to express my appreciation and give due credit to Dr. Joel E. Goldthwait, Dr. Robert B. Osgood, Dr. Lloyd Brown, Dr. Philip Wilson, and Dr. Lorain T. Swain for teaching me the little that I know with reference to the mechanical use of the body as well as the greater part of the orthopedic surgery that I know. I will also say at this time that I will use many quotations from these writers and lecturers, but will not trouble you at the time of using the quotation by telling you that they are from these particular men.

It might be a matter of interest to you to know that America today is leading in Orthopedics and, I am told, that it has led in Orthopedics for the past twenty-five years, having many internationally known men.

The subject that we are studying tonight should not be handled entirely by orthopedic surgeons but as orthopedic surgeons have for many years been interested in functions of the members of the body and the mechanical use of the body it seems to have fallen to their lot to do pioneer work in body mechanics as a whole. The remainder of the medical profession has been willing to leave this branch to the orthopedic surgeons when, strictly speaking, there are many phases of body mechanics which should be looked after by the internist and the pediatrician; for instance, viseroptosis. However it has not been my pleasure to see an internist who is particularly interested in viseroptosis other than what he can do with diet and the replacing of fat postperitoneally and in the abdominal cavity. I do not make this as a criticism but as a lamentable fact because it is my opinion that this particular condition should be handled by the internist or general practitioner and does not come under the phase, strictly speaking, of orthopedic surgery.

It has been very truly said that Joel E. Goldthwait of Boston, Massachusetts, is the father of body mechanics. It might be of interest to you to know that he became interested in this phase as a result of one of his own children, a so-called unhealthy child, but in whom no organic lesions could be found by the most competent men after thorough examinations. Having what we might call a genius for seeing things and overcoming them, he started to work with this seven or eight year old boy, whom he had been told would not live to adult life, and just before his death when drowned in Lake Champlain he was one of the most perfect specimens of young manhood that one could imagine.

It has been Dr. Goldthwait's desire to give humanity the benefit of his findings and his efforts to the extent that he has left himself open to criticism as many pioneers do. I grant you that he has gone from one extreme to another. Years ago he bore the name of Bloody Goldthwait because he would operate on anything of an orthopedic character. Today he never operates but has an assistant who does all his surgery. It is to this man primarily that I wish to express my appreciation. I have told you some instances of his life so that you with me may know how to appreciate him also when you think in terms of body mechanics.

When one stops to think of it we cannot help but realize that the human body is the most perfect machine that has ever been devised. In spite of our abusing it from our early childhood until we die, whether it be early or late, we have been so made by our Creator that our bodies compensate and take

*Read before Harris County Association, Nov. 18, 1931.
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care of the abuse which we give them. If this were not the case the human race would have been extinct years ago. With our automobiles, if we break something or there is a maladjustment of some of its parts, we take it to a mechanic and leave it with him until these are corrected. We are on the other extreme with our bodies. We push them along until they just will not go any further.

You take, for instance, the man who has worked in an office from early morning until late in the evening. He has been inside, probably using artificial light, all day and decides that he must have some outside exercise. Therefore he will walk anywhere from a mile to three miles to his home completely fatiguing muscles that are already tired and then wonders why he gets up the next morning just as tired as he was when he went to bed. That man should rest some thirty to sixty minutes and then get up and walk a few blocks briskly, carrying himself rightly and he would derive benefit from his walk.

You men stand on your feet all day long working with patients. It would be unreasonable to expect that what you need is walking for an exercise or pastime. It is very likely that you have developed the habit of standing with your weight on one foot. That is a very bad practice as it distributes the weight unequally and it will not be long before you begin to have trouble with your backs if you persist in this over a period of years. We have two feet and they should both be used, imposing on neither one.

There are three general types of people: the so-called normal, the slender, and the heavy types. There are many variations between these three land-marks and you will find some people who have some of the characteristic features found in all of the three different classes. This fact makes it rather hard at times to advise patients.

In the normal the thorax is full, the anterio-posterior diameter of the chest is about two-thirds that of the lateral diameter, the costal border should have an angle of seventy to ninety degrees, the diaphragm is high, and there is room under the ribs for the viscera. The viscera except the lower portions of the colon and the sigmoid and a very small part of the small intestines should occupy a position above the umbilicus. There is fat around the viscera and the posterior abdominal wall to protect from trauma the sympathetic nerves, ganglia, and blood vessels. The lower part of the abdomen is flat. The stomach should occupy a position close up under the diaphragm and under the protection of the left ribs, the liver should occupy a position on the right side similar to the stomach. These organs are attached to the diaphragm. Above the diaphragm the pericardium is attached by ligaments to the lower cervical spine, especially on the right side. Therefore, the pericardium and its ligamentous structures have been called the suspensory ligament of the diaphragm. Therefore, you can readily see that if one is slumped with the chest telescoping into the abdominal cavity, with the chest flat, the ribs pushed down, and the diaphragm low, the stomach and liver must inevitably be pushed down, as well as the small intestines, causing what is commonly called viseroptosis.

Do not misunderstand me. All people whose organs occupy this position do not have symptoms. However, you can readily realize that in a person with organs in this position there is a potentiality of a great difference in their physiological action because these organs were not intended to function in this position and if they do give symptoms one should not be surprised but we should be astonished that they function as well as they do in their abnormal position.

We will now discuss some of the findings in each of the other types of persons starting with the slender type which is usually of a lighter structure, very slender and with very little fat. One particular feature that is usually noticeable in these people is that the torso is unusually long and narrow. The ribs are lower and sometimes touch the upper part of the ilia. The articular facets are usually flat allowing them to be more flexible and, of course, bad postures are more easily obtainable. The attachments of the organs are less firm and this makes it possible for downward displacement when in the standing position. Having only a small amount of fat, the kidneys are more mobile as is the liver because the kidneys and the liver depend, to a certain extent, on a shelving of fat to help hold them in position. There are exceptions to all rules. Sometimes these people put on a very great amount of fat but it is soft and flabby, having little or no connective tissue in it and it really suggests poor health.

The herbivorous or heavy type of person in contrast to the carnivorous or slender type has a body built on heavier lines, having a heavy skeleton. Their muscle fibers are more coarse. There is much retro-peritoneal and general abdominal fat and one finds floating kidneys less often in this type of person. The joints are less flexible. The articular facets are usually crescentic. Due to the shape of these vertebrae and due to the articular facets the back is flatter and there is less motion than in either the normal or slender type of person.

One can distinguish between these three classes even in early childhood. The child which needs the greatest amount of attention and is most difficult to bring to adult life is the child of the slender type.

It is with people as it is with horses. You would not take a race horse and put him to a plow. neither would you expect to take a big heavy Clidesdale horse and put him on the race track. The head of a construction gang when calling for laborers to do heavy work, knows the type of man who can stand his work and calls for "broad-backed" men, but the head of a group of linemen for the telephone company or prospecting regime calls for the "narrow-back" because he does things more quickly, even though he is unable to stand the heavy load of ditch digging or such work. The same thing is true in athletic work. The hurdler or runner is of the normal or slender type and the wrestler, the boxer and the putter are of the heavy type.

We are all victims of habit. I do not contend that the human race is all naturally lazy, but we are certainly prone to allow ourselves to drift into slovenly habits and take the courses of least resistance. We, being the highest form of mammal, walk in the up-right position. Gravity is constantly tugging at our organs and the upper part of the body pulling them toward the center of gravity. It is obvious, of course, what effect this has on the abdominal viscera as well as on the torso. We are also endowed with intelligence and we should train ourselves to live a wholesome life, having healthy development and using our machine as nearly per-

fectly as possible that we may be able to overcome any stress or strain. "The way the body is used is of quite as much importance as the structure of the body itself." If we use our bodies rightly all of us have the potentiality of good health. But if either of the three types uses his body wrongly there are potentialities of ill health.

"In standing in the perfectly erect position the frame of the body is used in balance; the chest is held high and expanded, diaphragm raised, and breathing and heart action are performed most easily. The abdominal wall is firm and flat. The shape of the abdominal cavity resembles an inverted pear, large and round above and small below. The ribs have only a moderate downward inclination and the sub-diaphragmatic space is ample to accommodate the viscera. In this position, also, there is no undue pressure upon, or interfering with, the pelvic viscera or the large ganglia at the back of the abdomen and pelvis."

In the relaxed position we allow our bodies to droop forward, and weight is thrown imperfectly upon our feet which in turn necessitates a strain upon our knees; the inclination of the pelvis also is changed producing a strain of the low back and sacro-iliac joints. In the dorsal region there is a forward curve, the chest is flat to compensate for the dorsal curve, the cervical curve is increased, and a strain is placed in this region.

"The thing that is important in the interpretation of the many symptoms which the patients describe is that the body is most intimately related in its different parts so that no one part can be used wrongly without the body as a whole suffering." The so-called occupational posture very often makes its marks upon the human body and is quite difficult to correct.

It is a very common thing that we allow ourselves to sit in a slouched position which is unpardonable because this is not the position of rest. The same thing applies when we are lying down with numerous pillows under our head and shoulders. The breathing, circulation, digestion, and other physiological functions can not take place rightly yet "the most perfect anatomically may have the poorest health while the most imperfect anatomically may have good health."

In the carnivorous type we find the costal border very narrow; oftentimes it is hard to get the fingers between the costal cartilages of the two sides. The abdominal cavity is small, the diaphragm is working at a very great disadvantage. The diaphragm has been called the piston of the human engine. One writer has gone so far as to say that the diaphragm is more important in the circulatory system than is the heart. I can not conceive of this being true but I do consider that the action of the diaphragm during the respiration has a great deal to do with the rate flow of blood from the lower extremities and the abdominal cavity. By fluoroscopic examination and tracing of the diaphragm of the patient both lying and standing we very often find that it has an excursion of one-half inch. Compare this with the so-called normal from full expiration to full inspiration which is two and one-half inches. I cannot help but believe that this has bearing on the causation of varicosities and improper circulation of the lower extremities as well as with the pelvic viscera.

When a person of the slender type stands in a position such as we have just described the upper part of the sacrum upon which the spine rests is moved forward and downward. This naturally places a strain on the sacro-iliac joints and the lumbo-sacral region.

With the broad-backed or herbivorous type of person their troubles usually develop later in life because it is not such an effort for them to hold their bodies in a correct posture. The greatest difficulty that they experience is an abnormally large and heavy abdominal viscera and they tend to lean back in order to support this load in front, causing strain to the lumbo-sacral junction. In many cases lumbago is to be explained as a result of such strain. The abdominal walls are naturally stretched by the heavy viscera which allow it to sag less, however, than in the slender type person; but it is to be remembered that the degree of sagging does not determine the severity of the symptoms.

As mentioned before the human body is one machine made of many parts and if some of the parts are working wrongly the effects are felt by the whole mechanism. People often come to our offices complaining of their feet, stating that they have some ten or fifteen pairs of shoes at home but that none of them are comfortable. If we look at their feet and treat them for the conditions that exist in their feet, not considering the other parts of the body, we will probably treat their feet from now until dooms day, if they are satisfied to come to us that long. Their feet bother them as a result of strain. Due to the fact that they stand wrongly, walk with their feet turned outwardly, and, in all probability, with their knees partly flexed they are placing the greatest amount of strain possible on their feet. There is a great deal of difference between flat feet and foot strain. When we take into consideration that the muscles of the leg with their tendonous elongations are the structures which have to do with the position our feet are used in and when we consider that these musculatures become tired and oftentimes completely fatigued, it is easy to see that the inevitable result must be foot strain. Then the patient begins to walk in an abnormal manner in an effort to protect or relieve the pain caused from the foot strain. Soon their knees begin to give them trouble. Then, in a short time, they come in complaining about their backs. Thus, you can see that it would be a perfectly useless procedure to treat the patient's feet only.

The above is just an example of the things that we are often confronted with and it is mentioned only to show the necessity of considering the human body as a whole as well as its separate parts.

The use of body mechanics, I consider, is worth much more as a preventative measure than as a curative measure. It should be started when the children are in the primary grades in school and efforts should be made to get them to continue it until they are through college. Then the habit is so well established that oftentimes they will continue its use. However, if under the stress and strain of present-day life they do not continue to do as they know well how to do, it is reasonable to expect that they will stand the stress and strain better because they have a good working machine when they enter into this mode of living.

It is not the load that people carry in this world that "gets them down," as the phrase goes.

It is the position in which they carry their load. A very crude parallel may be drawn between the human body and a piece of timber. Take a piece of timber eight inches square and twelve feet long and fix one end of it in a block of concrete that is absolutely immobile with the timber perpendicular. Our mechanical engineers can figure out just how much of a load this will hold up but even you and I can be reasonably sure that it will hold quite a heavy load. Then take the same piece of timber or one similar, fix one end of it in another immobile concrete block but at an angle of forty-five degrees or thirty degrees or possibly even ten degrees and it is perfectly obvious to all of us that this piece of timber placed at an angle will support much less than will the truly erect piece of timber. This is, in a measure, comparable to the human body illustrating the ways and means in which we should use it and put our loads on it. Whether they are physical or mental the loads are there just the same.

One might ask, "How are you going to repair the human machine once it has been the victim of stress and strain?" That is not an unreasonable question at all. Nature is perfectly wonderful in her reparative processes once we give her a chance. Oftentimes the reparative processes will go right along while we continue to use our bodies and it is not necessary for us to go to bed for a prolonged rest, but certainly no one doubts the advantage of rest in any reparative process. However, when rest is prolonged too long our structures become weak due to disuse; atrophy takes place, so it is perfectly reasonable to expect that we should have graduated exercises under supervision done rightly, to accomplish the greatest amount of good, never reaching the point of fatigue in the structures which we are attempting to restore.

We often have to develop new habits of standing, sitting, and reclining to rest or about our work, using the parts of our body which were so built for the heavy work and favoring the parts of the body which are the most delicate. For example, from the lifting of a heavy weight to the mere picking up of a pin from the floor, use the structures in the thigh and protect the back. It is perfectly all right to lie down to read but do not choke yourself to death with pillows. Prepare an inclined plane of approximately thirty to forty-five degrees and let the bending take place at the hips and not in the dorsal or cervical region. You can see from the illustration what this will do to both circulation and respiration.

Our back is a multiplicity of bones and joints. You would probably be astonished to know the number of patients coming in to large clinics with their chief complaint referred to their back. Our backs, like other parts of the body, were created to be used but not abused, and if cared for they will function for us and give no symptoms whatever. Following in sequence is the fact that, if we use our back rightly, we usually use our torso rightly as well. When this is done the shoulders naturally assume their proper positions and the so-called round shoulders are cared for and do not occur.

We have discussed the three types of human beings, their possible overlappings, the conditions that are commonly found in these types of people, the importance of body mechanics as a preventative measure, and its use as an aid in a restorative process. It is my sincere hope that this discussion has been both pleasant and profitable to you.

A Vacation in Scandinavia

Anna Wetterhuus*

At different times I have heard the following remark made, "Yes, I went to Scandinavia this summer, but I did not see anything worth while in physical therapy," and I have wondered why, since physical therapy is so extensively used there, and since Sweden is the home of Dr. Ling. It can not be on account of the language, for everyone—even the policemen, understands English.

I visited in the three Scandinavian countries this summer, and I saw many interesting places—places which are open to and should be seen by any interested physical therapist. Let me describe some of the outstanding institutions in which physical therapy is practiced.

In Oslo, Norway, there is the Sophies Minde "Home for Cripples." This was first opened in 1892, as a small institution but since then has grown to a building four stories in height which covers a ground area of 3,000 square meters. It contains a fully equipped hospital, and a physical therapy department with modern equipment and a gymnasium, and they are now planning for an indoor swimming pool.

Classes from Kindergarten to High School are held for children who, on account of their disability, are unable to go to regular schools, and for older pupils there are also classes in Norwegian, writing, arithmetic, bookkeeping, drawing, music, and singing. Of special interest are the training schools in which the patients can learn to become self-supporting. Thus, there are training classes for tailors, carpenters, cabinet makers, painters, basket makers, shoe makers, book binders, a class in which picture framing and wood carving are taught, and another for training in the making of braces and artificial limbs.

For women there are classes in dress making, embroidery, knitting, lace making, weaving and cooking. Each patient is urged to enter the class best suited to his ability and inclination.

When the course in these classes is finished, the patient is placed in a position in which he can make his own living entirely, or at least contribute something to his own support.

The work in the institution is all performed by patients who are able to work, and some of the teachers are former patients.

I tried to get some moving pictures of a group of children doing their exercises. There were about twenty in the group, all patients with congenital hip dislocation who had been operated upon, but unfortunately I was not successful as the weather was too dull.

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I have spoken somewhat at length of the Sophies Minde Home for Cripples as it has so many interesting features and as it should be visited by every physical therapist who visits Oslo.

In Copenhagen there is a similar home for cripples. It is a larger and an older institution than the Sophies Minde Home but it is very complete. The Superintendent, Miss Anna Margaretta Speyer, said she felt she was the richest woman in Denmark, and I believe she is.

In Copenhagen the Finsen Institute is a place that should be of interest to all physical therapists. It contains a large room for the local treatment of cases of lupus. Of special interest here was the new Finsen Lamp of which the members of the Institute are very proud. This is a water-cooled carbon arc, properly weighted so that it is no longer necessary for a nurse to hold the quartz lens in order to secure compression. The first treatment lasts for one hour. By former methods a nurse was required for every patient; with this lamp, one nurse can take care of five or six patients. These patients also receive general radiation from a carbon arc as well as their local treatments. Various quartz electrodes are used in cavities such as the nose, throat, etc.

In Copenhagen there is also the Bispebjerg Hospital which has a large, very complete physical therapy department.

So much for certain outstanding institutions in which physical therapy is practiced. What can be said about the Scandinavian Schools of physical therapy? I visited two in Oslo, one in Stockholm, and one in Copenhagen. For admission to any of these the applicant must have completed the course in a Middle School, "Mittel-Schule," which corresponds to the High School in this country.

The length of the course varies from one and a half to two years. The training is very thorough. In each school anatomy and physiology are studied at the Medical School, with the medical students, and dissection of cadavers is required which also is done with the medical students.

I attended some of the classes in Oslo and found them most efficiently conducted. Most of the schools have modern electrotherapeutic equipment, mostly German machines.

All of the schools of physical therapy are under very close medical supervision and are inspected by the Government. In Norway, graduates from the approved schools of physical therapy are registered.

From this brief description of what I myself saw during a too brief visit to Scandinavia, it would appear to be obvious that there is much in these countries to interest and instruct the physical therapist. Scandanavia was the birthplace of physical therapy. It is today a center for the practice of the most approved methods of physical therapy.

Correction of Scoliosis by Turnbuckle Jacket*

By R. L. Carroll, M. D.**

Correction of scoliosis by turnbuckle jackets is a method in fairly general use, and is the one used at present at the Orthopedic Hospital of Los Angeles.

A plaster body jacket is applied as usual in which are incorporated anteroposterior hinges and turnbuckle opposite the concavity of the curve to be straightened. The hinges are made of aluminum to allow X-ray penetration so as to determine when sufficient correction has been obtained.

The most important part of the cast is a good fit around the occiput and chin. A thigh section is usually put on also, particularly if the curve involves the lower lumbar spine.

The jacket is usually put on with the patient standing or sitting on one buttock, and with moderate traction on the head to take up the slack in the curve. The cast is then allowed to dry for a couple of days, and a horizontal incision is made on the turnbuckle side to the axis of the hinges, and a wedge is removed on the opposite side leaving the cast in two sections held together by the hinges. The turnbuckle is then turned up a few turns daily according to how much the patient can stand at one time without discomfort, whereby head and pelvic traction is obtained with lateral bending to straighten out the curve. Usually correction is gained in from five to ten days.

In some cases where better compensation is desired, a horizontal turnbuckle arrangement can be made so as to get a lateral shifting of the two segments of the body cast without lateral bending.

The turnbuckle jacket is suitable for correction of all types of scoliosis. We have used it successfully on cases with the following etiology: congenital, empyemic, ideopathic and paralytic.

There is only one indication in our opinion for forcible correction of scoliosis by turnbuckle jacket, and that is preparatory to surgical fusion of the spine. As practically everyone knows, to stretch the ligaments of the spine and not have adequate support to hold the correction gained allows the spine to relapse into its previous condition and even further. However, on a couple of cases not desiring surgery and willing to cooperate with conservative measures we used the turnbuckle jacket to correct the curve and the spine was straightened. After wearing the body jacket with the spine in the corrected position for a while the jacket was removed, a back brace was applied and exercises begun, which however were inadequate to hold the correction gained, and the spine soon relapsed to approximately its previous position.

Another advantage of correction of scoliosis by the turnbuckle jacket is that the same jacket can be used to hold the correction gained during surgery by operating on the spine through a window in the back of the cast. The cast also furnishes postoperative and convalescent splint allowing the patient to

*Read before the Regional Meeting of the American Physiotherapy Association, April, 1933.

**Orthopedic Hospital, Los Angeles.

go home a couple of weeks after surgery, and it holds the correction while bony union is taking place. A turnbuckle jacket is usually left on from three to four months, and patients usually tolerate them very well.

Before and after X-rays of an ideopathic and a paralytic cases are herewith shown. The vertical line seen in the X-ray is the shadow of a plumb line. The X-ray is taken with the patient standing in front of it. This method is of great value in showing the exact position of the spine and pelvis as it is with the patient in an upright position. It was long ago devised by Dr. Charles LeRoy Lowman, chief-of-staff. It also permits exact measurement of the increase or decrease in the angle of the vertebra with the plumb line, and the latter of course is constant.

Where there are two curves to be straightened, of course one is straightened and the correction held by arthrodesis of the spine, and then the other is treated likewise.

Poliomyelitis

By Edward Le Cocq, M. D.*

Infantile paralysis, in its acute form, is encountered in the late summer and fall seasons of the year. The number of cases occurring yearly varies greatly and only occasionally does the disease assume epidemic proportions. During the present season there have been, fortunately, only a relatively small number of cases.

The principles of treatment in the acute stages of the disease are so well known to every competent physical therapist that it is hardly necessary to dwell upon this phase of the subject. It is however, never out of place to call attention to the supreme importance of rest, the prevention of fatigue, and the prevention of deformity in the acute phases of the disease. In the past untold harm has been caused by over-enthusiastic treatment.

Under skillful physical therapeutic management amazing restoration of function may be brought about in limbs which, at first, appear to be all but totally paralyzed. Even under the best of care however, a considerable percentage of cases show residual paralysis of a more or less disabling character, requiring operative correction. Of these permanent paralyses, involvement of the hip abductors is one of the most common and, at the same time, one of the most difficult of correction. As a result of paralysis of the gluteus medius and minimus the trunk has to be abruptly shifted to the opposite side in order to raise the paralyzed leg and allow it to swing forward. When the weight of the body is then thrown upon the paralyzed limb, the gluteals being incompetent to maintain the level of the pelvis, the hips are forced to swing over to the opposite side. The result is a severe limp and considerable difficulty in locomotion.

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A number of operative procedures have been devised for the relief of disability due to gluteal paralysis. Few of these are as effective and reliable as might be desired. Brief reference will be made to some of the methods employed.

When the tensor fascia is intact it may be utilized as an abductor by detaching it at its origin from the anterior superior spine of the ilium, and fixing it at a point more posterior and more directly above the trochanter. By transferring the tensor fascia in this manner this muscle is placed in a more favorable position for aiding in abduction.

Another method involves the utilization of the erector spinae muscle as an abductor. To accomplish this the lower end of the muscle is mobilized and then connected to the trochanter by means of strips of fascia.

The method which perhaps has given the best results, is that devised by Lange. In this procedure the vastus externus is substituted for the gluteus medius, thus restoring the power of abduction. The origin of the vastus externus is stripped from the femur, and to it are attached a number of strips of fascia. The fascial strips are then imbedded at intervals along the iliac crest.

As previously stated, muscle transference for abductor paralysis is not a uniformly successful procedure. However, when one considers the disability resulting from this type of involvement, some attempt at correction is entirely justified. We feel that all cases of gluteal paralysis which have received the maximum benefits that can be derived from physical therapeutic measures, and still have a severe and disabling limp, should be treated surgically after a method similar to those we have outlined.

The Accessory Scaphoid

By Paul W. Giessler, M. D.*

In October, 1929, Dr. Frederic Kidner of Detroit, Michigan, reported an operation for flat feet in which the accessory scaphoid was present. He calls it the pre-hallux, on the theory that it is a direct descendant of the sixth toe. It is an extra bone occurring in some feet, situated just internal to or somewhat behind and below the scaphoid. It may have a true joint between it and the scaphoid with cartilage and ligaments or it may be practically fused to the scaphoid. The tibialis posticus tendon attaches to it, nearly enveloping it as it passes on to the under surface of the cuneiforms and metatarsals. The path of the tendon therefore lies more mesial and dorsal than when it passes beneath the plantar surface of the scaphoid when the accessory scaphoid is absent. Kidner deduces from this condition that

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the tibialis anticus works at a mechanical disadvantage in this position; that instead of lifting the tarsus directly upward, the tendon is required to pull inward and backward and then upward, so that it pulls at an angle or around a curve instead of in a straight line and in so doing has to pull through a longer distance which in turn requires a greater muscular contraction. It was also noted that, as the foot was inverted, the soft tissues were crowded between the accessory scaphoid and the internal malleolus. These conditions result in the typical everted or flat foot, so often seen in company with the accessory scaphoid of any size.

I have recently operated on twelve such cases with uniformly good results. All of these cases had marked pronation and all complained of tenderness over the accessory scaphoid. The efficiency of the foot was markedly impaired and complaints varied from inability to engage in athletics to tiring on walking even a few blocks. The shoes were generally out of shape and in ten cases the scaphoid area was swollen and red and three cases had developed callus over the bony prominence of the accessory scaphoid. Active supination was definitely limited. Eight cases had tried other treatment, including Thomas heels, one-quarter inch lifts, arch shoes, Whitman arches and exercises, with partial relief in four cases, but no marked improvement in any.

The operation used was similar to the one Kidner advised. A curved incision was made along the tibialis posticus tendon with the accessory scaphoid as its mid-point. The tendon was exposed and freed above and below the accessory scaphoid. It was then freed from the accessory scaphoid by removing with an osteotome a thin layer of the accessory scaphoid, which remained attached to the tendon. Then the accessory scaphoid was removed and, if the inner edge of the scaphoid was still prominent, a piece of it was removed from its inner and under surface. Dissection was then continued laterally under the scaphoid. A deep chromic stitch then sutured the tendon to the plantar fascia in such a way that the tendon lay under the scaphoid and the raw surface of the thin layer of bone on the tendon faced the denuded surface on the plantar side of the scaphoid. During this fixation the foot was held in supination. After fixation, it was noted that the foot remained in supination. The wound was closed and plaster applied with the foot in supination. Casts remained on for six weeks; during the last two weeks the patients walked on the casts. After removal of casts, the heels of the shoes were raised on the inner edge. Whitman arches were used in four cases. Corrective exercises were given. The oldest case is now one year old, post-operatively; the youngest, five months. All are markedly improved in foot position, none having more than slight pronation. All report entire absence of pain or discomfort. All are more active than before. Three are not limiting their activity at all, even engaging in athletics. All can actively supinate, even when the weight is borne on one foot.

A more recent article by Dr. Kidner reports his continued success with this operation and, in addition, describes the use of the same operation in cases of flat feet without the accessory scaphoid, where the posterior tibialis tendon passes across the inner side of the scaphoid instead of under it.

Some Simple Principles of Physical Therapy and Occupational Therapy

By P. M. Girard, M. D.*

The basis for this form of treatment is first that an occupied patient is a happy patient, and second that the particular form of occupation which he utilizes may be so selected as to materially benefit the disorder from which he is disabled. Other than diversional occupational therapy, the science concerns itself chiefly with the production of active and voluntary motions. Especially in children can one accomplish much in obtaining motion in a joint or development of muscles. The child's attention is upon what he is accomplishing and he will voluntarily move a joint or muscles which he has persistently failed to move regardless of requests or other attempts to cause him to use the member. The principle of stretching and "pump-handling" a joint is wrong. Only such motions as the patient himself can make should be allowed. In this way, gradual increase in range of motion is obtained and the muscles developed at the same time. Much valuable work is being accomplished by the establishing of these departments in the hospitals of this country.

In conditions such as tuberculosis of the spine, a patient is necessarily recumbent for months or even years. These patients can lie upon their abdomens with a wedge shaped pillow under their chests and labor at work benches making shoes, cabinets, and even iron and steel articles. The head of the bed may be so constructed as to be turned down on hinges and serve as a work bench with a smooth and solid top. Electric drills and other machinery may be attached to this bench. Thus the patient's time is occupied with useful and profitable occupation. He is not fretful but happy and consequently his entire make-up is in better functional condition. The disease from which he is suffering will respond to treatment and nature's healing processes much more rapidly than if he were unhappy and restless.

All forms of physical therapy should be used scientifically and care used to avoid letting the patients assume that the sparking and sputtering machine to which they are attached has healing powers other than those actually proven. Many patients are constantly in search of some magnetic healing machine. Unless it is explained to them from the beginning that the diathermy machine used in their treatment is simply for the purpose of passing heat through a joint or other part, they sometimes get a mistaken idea of its purpose and value. The value of heat of course, is chiefly through dilatation of the

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blood vessels with increased blood volume to the part. The increased circulation nourishes the tissues and absorbs exudates, etc.

Another valuable branch of this field is hydrotherapy. Many therapeutic pools have been built recently in this country and much improvement is seen in such types of cases as poliomyelitis, arthritic joints and traumatic joints by their daily use. The principle involved here is by use of the buoyancy of water. The large part played by gravity is eliminated. The patient's fears of being hurt are gone and he moves his joints with as much freedom as possible. In poliomyelitis the weakened muscles which otherwise could not move a limb, can move the limb in water and therefore satisfactory muscle training is obtained.

Other very important branches of physical therapy are the electrical stimulation of muscles and nerves, the postural training, etc. However, in this brief sketch, suffice to mention them.

Orthopedic cases which are merely examined, diagnosed and operated upon without adequate follow-up physical therapy are usually poorly treated cases.

Ankylosing Arthritis—Is It Hopeless?

By Betty A. Rice*

One of the most gratifying cases which has come to our department recently, is that of a girl of fourteen. She was admitted to the hospital in May, 1932, with chronic ankylosing atrophic arthritis involving practically all of her joints.

In February, 1930, pain and swelling in her ankles and knees were first noticed. The fingers were next involved. As time went on, the involvement included the right hip, both wrists and both elbows. In October she went to bed and was in bed or in a wheel chair for twenty months. In the early stages her temperature would run as high as 104° for several weeks at a time. There was no history of acute respiratory infection or tonsillitis. She had been constipated for many years, needing enemas daily.

The case was seen by the medical staff who said that the disease had progressed so far and so much damage had been done to the joint surfaces, that there was no hope of relief from vaccine therapy. The neurologist said that the case was not suitable for a sympathectomy. She was recommended to be discharged as a hopeless case.

On consultation the orthopedic staff felt that some reconstruction work could be done so she was transferred to that service.

The X-rays showed the right hip ankylosed in a position of flexion, rotation and adduction. The right knee was ankylosed in a position of about 45° flexion. The left hip showed quite free motion. The left knee was partially ankylosed in the straight position. The left ankle and foot were ankylosed in equinus. It was thought that a series of arthroplasties could be performed with success.

On July 11th, an arthroplasty of the right hip was done. After four weeks, physical therapy treatments were started on this hip. A fair degree of motion was being developed when the necessity for an appendectomy on October 15th prevented treatment for three weeks.

On November 28th, a tenotomy of the left tendon achilles was done. At the end of December, there was about 40° of painless motion in the right hip.

The next step was an arthroplasty of the right knee on January 9, 1933. Treatment could not be started at the regular time because of infection which developed in the knee. This was treated with infra red and cold quartz. On March 17th, physical therapy was started again. After a month there was 35° of free painless motion which gradually increased to 90°. Due to some lateral instability of the knee, it was necessary to have a long leg brace. Walking with crutches was then begun.

From the beginning physical therapy consisted of dry heat, general massage and exercise to all the joints not definitely ankylosed. Increasing the tone of the muscles involving the ankylosed joints before operation, was a contributing factor to the good results obtained later. At the end of the first year, there was a great improvement in the hips, right knee, finger and shoulder movements.

The arthroplasties were treated with heat, massage and very gentle assistive active motion. As near the full arc of motion as possible was made, with rests and assistance and long rest periods given between each movement. There was great muscle weakness at first, but gradually less rest was necessary and the movement could be made unassisted. We have found that better results are obtained if there is no forcing of the joint. Overwork will cause the joint to stiffen.

On August 14th a wedge osteotomy on the right wrist was done and the left wrist stretched in a cast. In two weeks the latter cast was bivalved and motion was started. Two weeks later, the cast was discontinued. Motion in the wrist and fingers was definitely improved. After six weeks the cast was removed from the right hand and the wrist was in excellent position.

On September 25th, an arthroplasty of the left elbow was done. At the time of writing, the elbow has 90° of free movement and the patient can get her hand to her mouth for the first time in three years.

Instead of a helpless cripple, in a year and a half we have a young girl who is walking well with crutches and fairly well without them. When the other knee and elbow are reconstructed she will be able to do many more things for herself. Surely it was worthwhile making the attempt to give her a more normal outlook on life.

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The Physiotherapy Review is published bi-monthly by The American Physiotherapy Association.
Editorial Office, 719 Barry Ave., Chicago.

Vol. XIV January-February, 1934 No. 1

Convention Notice

The Cleveland Chapter is very happy to extend its most cordial welcome to the next convention of the American Physiotherapy Association, which will be held at Hotel Cleveland, Cleveland, Ohio, on June 13, 14, 15 and 16, 1934.

The program is still in the making and will appear in the next issue of the Review. There will be hours set aside for serious discussions, and there will be instructive clinics and visits to various hospitals. The Program Committee is also aware of the value of relaxation and good fellowship.

The American Medical Association will meet in Cleveland at the same time, and we are assured of a varied and interesting week.

We hope every member of the A. P. A. will make an effort to come to Cleveland. Remember June 13, 14, 15 and 16, 1934. Set aside these dates and plan to come.

We need one another in the work which is before us. We need to exchange ideas and discuss new methods. Let us take this opportunity to get together to become better acquainted and carry away with us the inspiration so much needed in our work.

* * *

The Cleveland Committee on Exhibits makes an appeal to the chapters for material for our exhibition room. We want to make this feature of the Convention in June of special interest professionally. Therefore, if any of you have photographs showing any phase of your work, any special apparatus that you use, children's educational toys, or anything in which you are interested and which has educational or therapeutic value, we would welcome your cooperation. A letter will be sent to each chapter later on, but meanwhile put on your thinking caps. We have arranged for a room for exhibits, so we shall have adequate space. *Cleveland Chapter.*

To Our National Associates

A plea for help to save our local chapters seems to be imperative. I do not know whether or not it is the depression that is to blame, but several members who have joined the National Association have withdrawn their membership from the local chapters and remained members "at large" in the National Association. If that practice is permitted to continue, there will be no members left for our local chapters.

Sometimes the reason for withdrawal is given as financial difficulties. Another is that the local chapter is too far away for the member to derive any benefit from lectures and meetings, etc.

I have a suggestion to make. Every National member should be compelled to be a member of a local chapter. If there is one in her city or state, well and good, but if not, she should join the nearest local chapter in an adjoining state, or a chapter in a certain territory, that is, West, Middle West, or East.

It is through the local chapters that the National Association can keep in touch with its members and their practices. No other national organization of doctors or nurses considers a membership unless a person is in good standing in his county or state organization. *Cleveland Chapter.*

New blood, courageous blood, joins our ranks. Even in the face of depression we find young hearts that are willing to learn and try for their place in the sun; and so, last August the Children's Hospital School of Physiotherapy graduated its class of three.

The setting was most appropriate for it was the Garden Dining Room of the Women's Athletic Club. At 6:30 p. m. on August 11th, 1933, a banquet was given honoring the Graduating Class of 1933. Mrs. Albert Crutcher, President of the Hospital Board, Miss Lilla Swift, Superintendent of the Hospital, Miss Lillie Graham, Director of Physiotherapy and the Orthopedic Staff of Doctors and their wives.

Miss Swift told of the marvelous and untiring work of Mrs. Crutcher, and of the new building which is now being erected in her honor commemorating twenty-five years of service as President of the Hospital Board. Dr. John Wilson, Chief of the Orthopedic Staff, delivered the address to the graduating class and presented the diplomas. Miss Graham gave a short address following which she bade the guests farewell before departing for a year's leave of absence abroad.

Southern California Chapter.

ABSTRACTS

By John S. Coulter, M. D.

The Present Status of Physical Therapy in the United States. Richard Kovacs, M. D., Chairman, Special Committee on Physical Therapy, Medical Society of the County of New York. The British Journal of Physical Medicine, September, 1933.

Physical Therapy has made considerable progress during the past fifteen years in the United States. The factors in this success have been physical therapy societies, the Council on Physical Therapy of the American Medical Association, and the special physical therapy committees in some of the State and County medical associations.

The Council on Physical Therapy

The establishment of a Committee of the Board of Trustees of the American Medical Association, with functions similar to those of the well-known Council of Pharmacy and Chemistry, was decided on in 1925 by the House of Delegates. The resolution provided for a Committee of nine, selected from chemists, physicists, pathologists, physiologists, radiologists and clinicians, to compose the Council on Physical Therapy. To insure impartiality, none of the men practicing physical therapy were at first made members. According to a recent statement of the Chairman its aims and purposes are threefold:

1. To protect the medical profession and thereby the public against misleading and deceptive advertising in connection with the manufacture and sale of devices for physical therapy.

2. To disseminate such reliable information as it possesses or may acquire, and to stimulate instruction to aid the practicing physician to choose true and sound physical therapy methods.

3. To act in an advisory capacity to the profession and to the public in all matters concerning this form of therapy.

During the eight years of its existence the Council has published some forty articles in the Journal of the American Medical Association on the general aims, methods and scope of physical therapy, as well as on many of the special phases. A collection of these articles was recently published.

Three members of the Council have successfully undertaken the laborious task of writing and editing a loose-leaf three-volume work, "Principles and Practice of Physical Therapy."

Committees in State and County Medical Societies

To counteract abuses by technical personnel and "cultists," and to acquaint the profession with the legitimate employment of physical measures, some State and County Medical Societies followed the example set by the American Medical Association and appointed Special Committees on Physical Therapy. The Medical Society of the State of New York was the first to do so, and its Committee during the past three years succeeded in definitely establishing the principle throughout the entire State that physical therapy forms part of the regular practice of medicine and must be applied only by or under the immediate supervision of adequately trained physicians. Other State Medical Societies have since appointed similar committees.

Physical Therapy in Hospitals

It is being gradually recognized by the profession and by hospital authorities that a physical therapy department should form an integral part of every modern institution devoted to the sick or injured.

A survey of the hospitals of New York State in 1930 showed that fifty-seven percent possess a physical therapy department and that thirty-four percent of the remainder planned to organize one. With a few exceptions these departments were under the direction of a qualified physician. The 1931 hospital report of the A.M.A. reports 2,236 physical therapy departments in hospitals, compared to 4,523 x-ray departments.

Technical Personnel

The Council of Physical Therapy states:

"The training of technicians should be encouraged, for trained technicians are invaluable to physicians specializing in this field. But technicians should be discouraged from establishing individual plants."

The Medical Society of the State of New York states:

"Trained lay personnel (nurses and technicians) are indispensable in institutional work, but the initiation and prescription of physical measures belong solely to the physician. Physicians should not refer their patients to private offices of masseurs, gymnasts or technicians, because of the lack of adequate supervision there."

Some hospital authorities have installed technicians in full charge of physical therapy departments, thus making impossible the rational use of physical measures by all departments of the hospital, as is possible when there is a medical man in charge. In not a few instances the entrenchment of technicians prevented the appointment of a competent physician. In other instances the contacts established enabled technicians to set up their own establishments in competition with the medical profession. Licensing of technicians for independent practice, through misguided political influence, led to a further aggravation of the situation, fortunately only in a few instances. In New York State, for instance, in spite of the belated opposition of the better informed members of the medical profession, registered physiotherapists became licensed by a loose clause of the Medical Practice Act (1926) so as to practice nominally under a physician's supervision. No provision was contained, however, in the law how the supervision was to be carried out, nor for revoking the license for due cause. Almost four hundred persons were thus licensed under a waiver provision, that is, without passing any examination and with only a nominal show of credentials. Among these licensed were former chiropractors; naturopaths and graduates of inferior commercial massage schools. No wonder the properly trained physical therapy technicians declined association with this "registered" group.

There are, however, several redeeming features. Even in democracy the law of the survival of the fittest still operates. Poorly trained technicians, licensed or not, are out of the race before long. Technicians' training courses have been established in increasing number

in hospitals, medical schools and in universities. This and the present economic depression will most likely tend to eliminate most of this inferior training. Discussions and surveys on desirable standards for technicians have been undertaken by medical societies jointly with the representatives of high class technicians, and it is expected that the much needed correction of the designation of technicians will enable a still closer co-operation.

All those who have given the subject careful consideration agree that a nation-wide registration of acceptable technicians would be desirable.

Modern Methods in the Treatment of Chronic Arthritis. By Vincent Coates, M. C., M. A., M. D., M. R. C. P., Senior Physician, Royal Mineral Water Hospital, Bath, in the Practitioner, 131:4:454, October, 1933.

Rheumatoid Arthritis

By rheumatoid arthritis is meant a systemic disease of unknown origin with deviation from the normal in both bi-chemical and metabolic aspects, though infection is thought to be an essential factor. The main manifestation is a non-suppurative polyarthritis of subacute or chronic type which tends to deformity of varying degree and expression.

(1) A correct diagnosis is essential.

(2) The treatment of every case of rheumatoid arthritis is orthopaedic from the very start. This statement requires qualification. It is not meant to imply that only an orthopaedic surgeon is capable of treating a case of rheumatoid arthritis or even that he should do so unaided.

Prevention of deformity and contraction: It is within the power of every medical practitioner to prevent much deformity in the early stages of development of rheumatoid arthritis in any given joint. Tendency to restriction of the range of movement of a joint necessitates the assumption of a correct position, if need be in splints or in plaster casts, relieved in the former case by daily movement. Correct positions may be envisaged by the stance of a waiter who has just raised a moderately heavy tray above his head. The fingers are nearly extended with slight deviation toward the thumb; the wrist is dorsi-flexed; the forearm is somewhat supinated; the elbow is flexed at about 90°; the shoulder is in extension; the hips have the femora slightly abducted; the knees are extended fully, or nearly so; the feet are at right angles to the lower legs and slightly inverted.

Movement: "A movement a day keeps adhesions away" is a good motto. A full movement, active if possible, otherwise passive, should be carried out by all joints not limited by adhesions. These movements should be without strain, that is to say, no joint should be moved while taking weight but a good masseuse can coax movement in even a very painful joint. Sometimes relaxation can be attained only in a hot bath after the taking of aspirin. If insufficient movement is obtained owing to pain and muscle spasm periodic movements under gas anaesthesia should be carried out. No hot swollen joint should be allowed to bear weight.

It is beyond the scope of this paper to discuss manipulation in detail, much of which, though not all, pertains to pure orthopaedics, but several points are worthy of note: (1) Radiograms are essential, but their use is limited. (2) It is desirable to estimate the sedimentation rate before undertaking manipulation. (3) Manipulation never seems to result in a flare-up of a pyogenic nature. (4) Leverage should be short, and it is wiser to manipulate in series rather than to do too much at any one period. This applies to manipulation of a single joint as well as of several. (5) It is good policy to take an x-ray after manipulation. The bones in rheumatoid arthritis are very friable and the snapping of a bone may be regarded as that of a tough adhesion.

(3) Prolonged rest is a necessity and education of the patient desirable. In the early stages most of the twenty-four hours should be spent in bed. Fatigue has to be overcome, temperatures have to settle down and the resistance has to be built up. Education is an important factor in every case. Patients must be taught to live within their physiological income, that the joint capital must not be encroached upon and that no joint must be used beyond its capacity. During the period of rest and education, apart from the systemic aspect of the disease, the treatment of the joints themselves by electrical methods and external applications is one requiring observation and trial. Scott's dressings, inunction of mercury, diathermy, ionization, the cautery or blisters may all be called upon, to name but a few therapeutic measures.

Hypertrophic Osteo-Arthritis

By hypertrophic osteo-arthritis is meant a chronic degeneration affecting the joints in those of middle and late life, particularly the hips and spine of men, the knees of women and the terminal phalangeal joints (Heberden's nodes), in the so-called leisured classes. Wear and tear seem to be the determining factors though there is a familial strain to a minor extent.

Some degree of hypertrophic osteo-arthritis is to be expected in the decline of life, almost as certainly as the advent of grey hair, but on the onset of symptoms an exact diagnosis should never be neglected.

In the earlier stages there are briefly three main disabilities to be combatted: pain, muscle wasting and loss of movement. Pain: Pain calls for rest, which may be absolute (with or without extension by weight and pulley) or relative, drugs of the coal tar series, codine and hyocyamus, and diathermy. Muscle wastage: Here massage is paramount. Loss of movement: Obviously some form of exercise is necessary without weight bearing. Fortunately there is at our disposal just that form of treatment which allows of movement outside the influence of gravity, in a supporting medium and at such a temperature that spasm is relaxed. The deep baths at Bath are so constructed that these are entered by descending shallow steps which lead to a bath below the level of the floor. The natural water is hyperthermal and is of such buoyancy that movement is aided and not restricted. The patient stands in water almost up to his neck and moves above the floor of the bath carrying out the movements prescribed by his physician. The pool bath is a specialized form of deep bath. Here the patient lies in a sling and the attendant carries out passive movements to his limbs which are submerged and lying free. The fact that many cases of hypertrophic osteo-arthritis of the hips return to Bath year by year to regain once more the loss of movement which twelve months of greater activity in ordinary life must demand as a toll, is proof in itself of the efficiency of this line of treatment.

Physical Therapeutics in Hemiplegia. I. M. Leavy, M. D., New York, in Arch. Physical Therapy, XIV:7: 407, July, 1933.

Heat

Heat, applied locally to the paralyzed limbs, should always precede massage and therapeutic movements, which are enhanced in their effect, and better tolerated by the patient. It has already been mentioned that it is

best to start the application of heat as early as the first or second week of the cerebral attack. This affords comfort to the patient and considerable relaxation to the part. These patients complain of pain in the arm and shoulder joint, and there is nothing which affords quicker and greater comfort than warmth and support. This latter can be arranged by having the patient's entire arm and forearm rest on a large pillow in flexion and abduction; or the sleeve may be fastened to the pillow or bed with a safety pin. It is to be emphasized that this support must remain until there is a return to voluntary power in the upper extremity. Later, when the patient is in a wheel chair or in the erect position, there will be a tendency to allow the limb to hang down the side, causing relaxation of the shoulder muscles, stretching of weak muscles and shortening of the stronger muscles (contractures) and luxation of the shoulder joint due to stretching of the shoulder girdle muscles by the weight of the arm. This not only causes pain and discomfort, but makes the eventual restoration of muscle function delayed and more difficult. Ambulant patients are advised to wear a sling supporting the arm, or to insert the hand into an opening of the shirt or coat.

Massage

A frequent accompaniment of hemiplegia which hinders the progress of recovery and voluntary power, especially in patients who are sitting up or in the wheel chair, is edema of the dependent parts. This is probably due to several factors: vascular disturbance, absence of muscular contraction which assists in returning the peripheral blood supply, and dependent weight of the limb. Massage in the form of light stroking produces a definite change in the distribution of blood in the superficial capillaries, and substitutes for activity in those who have led active lives and are now confined to the sedentary and inactive existence of convalescence.

Mennell suggests that massage in edematous extremities be performed from above first, as it is difficult to force fluid from lymph spaces (in the lower extremity) of the foot into those of the leg, which is already water-logged. Those of the leg should be emptied into the thigh and then followed by massage of the foot. The limb should be elevated for a considerable period of the day, and gradually lowered as the edema recedes. Increased motion, passive and active, and restoration of muscular activity will assist in eliminating edema.

Therapeutic Exercise

The value of massage lies not only in the action mentioned but as preparation to the therapeutic exercises, first passive, then active, which are so necessary for ultimate restitution. We must, at this particular period, begin the therapeutic exercises exclusively by the masseur or technician—passively, so that the patient may not only feel the movements of the limbs, but learn to produce voluntary movements as well. These movements must be performed under proper supervision and in gradual stages beginning with the passive exercises by the operator, to the assistive and resistive, at first with minimal effort, then to the final exercises performed by the patient himself.

In these initial therapeutic exercises, as in massage, the limb should be completely relaxed, and with firm and proper support by the operator movements are made carefully and diligently, without strain or pumping, and only in the direction in which the joint is capable of voluntary movements normally. There must be a proper understanding of normal movements in each joint before exercises are given.

After the passive movements by the operator, advance is made to the assistive, or that movement by the patient assisted by the operator. This helps to restore confidence to the patient and assists in conditions where voluntary power is very weak.

From this, progress is made to the resistive, or the movement by the patient against the gentle resistance of the operator. This form of exercise is especially adapted where it is desirable to concentrate efforts on groups of muscles. Resistance should be made to the active movements of the contracted muscles, as well as the antagonists. The amount of resistance should vary to meet the requirements in each case.

The manual therapeutic exercises are the forerunner of the active exercises performed exclusively by the patient later. However, the routine of baking, massage and exercises is continued throughout the entire period of care and treatment of the patient, to maintain and increase their advantages.

Electrotherapy

There is a difference of opinion as to the value of low voltage currents in hemiplegia. We have observed cases with and without electrical application, and though there is no direct experimental evidence, there appears to be a more or less appreciable effect with its use. Many cases, without any evidence of voluntary movement, seemed to have had their first start from electrical stimulation. Patients who have attempted to exert all their will power to produce a semblance of contraction in affected limbs, without avail, have obtained a result, though very meager at times, by the stimulus. Unquestionably, many of these cases would at a later period develop some voluntary power, but this essential responsive action is hastened.

In the use of electrical stimulus to hemiplegia, the most desirable effect is from the simplest means. Avoiding the complexities of intricate apparatus allows ready facilities for application, less interference, and maintenance of the proper modality.

Therapeutists have their favorite applications, either faradic, sinusoidal, surge, straight or interrupted galvanic. The choice of the sinusoidal, surge, straight and interrupted galvanism is a matter of habitual use of these modalities. There is very little to choose in their efficiency, and preference is often given to the sinusoidal because of its more soothing effect. It probably has its better selective action on unstriated muscles. It is of advantage that the application of electrical current should be fairly rapid and constant in its flow, sufficiently to cause a limited period of contraction. It should stimulate, as nearly as possible, normal muscular contraction with the corresponding rest period—avoiding any prolonged action and fatigue to the muscles.

We have been using, and find satisfaction in the application of the interrupted galvanic current. It is obtained from a simple apparatus, exerts its effect on nerves and muscles, hence produces contraction in the groups of muscles necessary for coordination and movements, gives a chemical and polarity effect soothing in character, and affords a definite rest period.

Active Exercise

The final consideration in the physical treatment in hemiplegia is that of active exercise—perhaps the most important of all the physical measures. Practically all therapeutists are agreed that it is most important in necessity and results. The purpose is to improve or increase proper coordination between nerves and muscles and obtain voluntary contraction of the muscles.

It is known that muscle reeducation entails the consideration of two factors—muscle rest and muscle action. An intelligent combination of both is imperative if recovery is to be hastened to the fullest extent. A muscle that is weak can never recover its power if it is subject to a constant strain. One should limit the action of antagonist muscles while leaving weakened muscles free to act as soon as they have the power to do so. The antagonists must be taught to relax and weakened muscles must be provided with work which is not beyond their strength.

In the use of the simple pulley and weight overhead machine when the abductors relax, the weight elevates the limb in abduction and then the adductors pull it down again. By reducing the weight more work is given to the abductors until with the absence of weight, a full, free, standing movement of abduction is performed against gravity. Throughout the exercises instruction must be given to relax strong muscles and contract the weak ones.

Coordination must be practiced by the patient. In the lower extremity the usual start may be with the leg swinging, advancing until the patient performs a full bicycling movement in the air, or by resting on the well leg, perform alternate flexion and extension of hip, knee, and ankle. This may be further advanced by sitting on a chair or bicycle apparatus and practicing bicycling. The apparatus has the advantage of permitting movements of the lower extremities without bearing of body weight.

In institutional mechanotherapy we have better means of selective active exercises, particularly where apparatus may be regulated by movable or removable weights, so that the initial efforts of the patient may not be readily exhausted. These machines must be properly adapted to the gradually increasing power exerted by the convalescing patients, and must be varied in such power to meet the possible efforts of patients. The equipment should include an arrangement of apparatus which will give the proper exercise and muscle education to joints of the upper and lower extremities, and should correspond with the normal movements of these joints. A pulley weight machine may give considerable satisfaction in the movements of the upper limbs, but separate apparatus for abduction, adduction, and rotation of shoulder, or for pronation or supination of the forearm, will add greatly in performing these movements. In lower extremities the bicycle apparatus is an excellent machine for movements without the body weight. Any apparatus that is readily adjustable to meet the normal movements of the various joints of the extremities will suffice, whether it be a Zander, McKenzie, or one constructed by a carpenter.

Evaluation of Therapy in Chronic Atrophic Arthritis. By W. Paul Holbrook, M. D., F. A. C. P., Tucson, Arizona, in Ann. Int. Med., 7:4:457, Oct., 1933.

The treatment of chronic arthritis is still passing through a phase of promiscuous therapy, much as tuberculosis did twenty years ago. There has been a tremendous increase in interest concerning rheumatic diseases during the past ten years, and, as a result, the medical literature has been flooded with reports of cures accomplished by all conceivable types of treatment. As a consequence, the majority of clinicians have been unable to separate fact from fancy. Diets, vaccines, colonic irrigations, various forms of electro-, physio-, and hydrotherapy, typhoid vaccine injections, the administration of scores of chemicals orally or by injections, endocrine therapy, postural correction, and even the manipulation of the feet, have all been hailed to the public, and too often by the medical press, as the answer to the problem of treating chronic arthritis. It is most unfortunate that many of these methods have been made available to the general profession, for some of them are not only worthless, but are instruments of incalculable harm. The many remedies offered are of course the best evidence of a lack of specificity.

In an attempt to evaluate the many therapeutic procedures, the last 1,000 cases of chronic arthritis passing through the hospital and clinic of the Desert Sanatorium have been grouped according to the different types of therapy employed and have then been carefully analyzed with regard to response.

General Measures

Rest and Exercise. One of the first problems confronting the physician is determining the relative proportion of rest and exercise desirable for a given patient. In general, rest should be directly proportional to the acuteness, and inversely proportional to the imminence of ankylosis. Exercise should almost always be active and almost never passive. Motion should be limited to within the painless arc, but pushed to the limit with some assistance. All exercises should be done slowly and exactly, with a rest interval before the next one is begun. We use under water exercises in much the same way as they are used at Warm Springs, Georgia, for paralytics. A very much wider range of joint motion can be secured without pain or muscle spasm than is otherwise possible. By varying the temperature of the water, any degree of sedative action or of stimulation can be secured. We are firmly convinced that the salvation of many patients with chronic arthritis depends upon regular and wisely directed exercise, for with atrophic arthritis in its more chronic phases, it is truly a case of use or lose.

Heat and Massage. The application of local heat to the joints is, in our opinion, utilized too much and is a factor in keeping an arthritis active that might otherwise subside. The greatest precaution should be exercised in utilizing heat, unless the stage of the disease is a very chronic one. Diathermy, as a method of heat in these atrophic demineralized joints, has in many instances precipitated exacerbations and has produced further demineralization. Massage, in the acute stages, should be avoided, and only with increasing chronicity should stimulating massage be used. Light massage can be used very early and is the best substitute if active motion is not possible. It is in other types of arthritis that heat and massage are indispensable. It should be noted that the "a" group tolerate heat and massage much better than the "b" group. Local heat to the joint ought not to be followed at once by exercise, as is generally done. Stripping, depletion massage, or rest should precede exercise as further damage will occur in exercising an engorged joint. Massage and active educational exercises provide three-fourths of the physiotherapy given in our Hospital. It should be pointed out that little special equipment is necessary for this work, but a trained personnel is essential.

Prevention and Correction of Deformity. In every case of atrophic arthritis, the possibility of residual deformity in any and all involved joints should be anticipated. The prevention of such deformities can be accomplished only at the price of eternal vigilance. Their correction requires infinite patience. Nearly all deformities in this unhappy disease occur in flexion. Particularly is this true of the spine, elbows, wrists, hips, and knees.

Eighty per cent of all patients with chronic atrophic arthritis, entering our clinic, have a flexion deformity of one or more joints, which might have been prevented. In the acute stage the joints should be at rest at the normal angle of relaxation. Light splints, or light weight plaster of paris shells are most useful in maintaining the ideal position of the joint. Weight bearing upon a bent knee is not only painful, but increases the deformity. Flexion deformity of the knee can usually be prevented by the simple use of a posterior splint, and a knee already so deformed can in most instances be straightened by the application of a series of plaster of paris posterior shells. Painful pressure, wedge casts, and calipers are not usually necessary, as relaxation and protection will usually bring the knee to a normal weight bearing angle. Corrective exercises accompanied by proper rest are necessary. Group muscle exercises, particularly of the extensors, can be done without joint motion and should be carried out routinely.

Diet. Diet does play a very real role in the treatment of these patients. Dr. Pemberton of Philadelphia has said many times all that can be said on this subject, and with him we are in hearty agreement. A diet low in concentrated carbohydrates and high in vitamins is essential, where the patient's state of nutrition will tolerate it.

Bowel Management. The majority of patients with atrophic arthritis have a history of gastrointestinal disturbances and, in most instances, complain of constipation. The colon is often tortuous, the sigmoid redundant, and there are areas of spasm in an otherwise very atonic bowel. Routine proctoscopic and sigmoidoscopic examinations, with cultures from the mucosa, have been made in more than 200 of these patients. The majority show some deviation from normal in the mucous membranes. Proctoscopic examinations have been repeated after a series of colonic irrigations, oil enemas, acidophilus implantations, etc., without noticing, except in a few instances, any demonstrable change in the mucosa. There is no doubt but that in our experience adequate bowel elimination has contributed to the patient's comfort and that joint exacerbations do occur in a number of patients when gastrointestinal disturbances occur. Adequate intake of vitamins is helpful, but we have been unable to demonstrate with any regularity the remarkable changes in the colon on this routine reported by other investigators. The stool reaction of these patients is nearly always alkaline. Normal stools are neutral or slightly acid. The colon bacillus grown at the pH of a normal stool is non-pathogenic for animals. The same organisms grown in an alkaline medium become highly virulent for animals. We have had considerable success in a small group of patients by maintaining a slightly acid reaction of the stool. Further work is being done in this field. Bowel regulation is ordinarily maintained without cathartics by the use of a good mineral oil, or mineral oil and agar by mouth. A small retention oil enema may be used at night if necessary. It is difficult properly to evaluate therapy, but a sufficient number of patients have been seen who present demonstrable changes in the joints with faulty bowel management to convince us that it does play a role in some patients.

Removal of Foci of Infection. (One hundred patients.) The removal of foci of infection in the "a" group of atrophic arthritis has been very disappointing. No single patient that we have seen in this group has unquestionably benefited by the removal of a focus.

Transfusions. (Seventy patients.) Patients in the subacute and early chronic phases of infectious arthritis, with or without anemia, respond well and in not a few instances dramatically to a series of small blood transfusions.

Vaccine. (One hundred patients.) Undoubted clinical improvement, not easily accounted for otherwise, occurred only occasionally. No single one of the above groups did well enough to show clearly superiority of results over other groups not receiving vaccine. Our best results with vaccines have occurred where an autogenous organism, which showed a strong positive skin sensitivity test, was used in small desensitizing doses intravenously. We have had a few dramatic results in this group of patients. The use of vaccine is not without hazard, as we see daily in the clinic patients who have had very unhappy reactions from its use. We have had an occasional unfortunate result in our own practice, in spite of exercising the greatest care. No patient offers a more difficult therapeutic problem than one who has had unfortunate vaccine reactions or one who has been highly sensitized by its use. Shock therapy, either by vaccine or nonspecific protein, is a hazardous procedure in patients with early or subacute forms of atrophic arthritis.

Climatic Therapy. (One hundred patients.) Some months ago it occurred to this writer that climate might best be studied if comparable groups of non-nomadic people living under different climatic conditions could be investigated. Arrangements were made for a survey on a tribe of Indians who have lived continuously on the Tucson desert for several hundred years. The incidence of atrophic arthritis in these Indians could then be compared with that of Indians in other climates. This survey is still in progress but no cases of atrophic arthritis have been seen yet among these 5,000 Indians.

One hundred and twenty-two physicians of this locality were written to, or interviewed, regarding the incidence of atrophic arthritis in native residents of this vicinity. There were but two cases reported. We have seen only one case of atrophic chronic arthritis in a resident in the course of this last 1,000 patients.

It is also of interest in this connection to note that rheumatic fever is very rare in this locality and to report that of fifty-two patients referred to us in the past three years, with recurrent rheumatic fever, no patient has had a frank recrudescence during his stay here.

One hundred patients with atrophic arthritis were selected for this study on climatic therapy. They were selected without reference to severity of disease, but on the basis of having been treated as nearly as possible by general and special climatic modalities alone. No patient was included who had foci of infection removed, or who was treated with various specific medications or vaccines. Patients who had special diets and exercises could not be excluded, and there were without doubt many other uncontrolled factors. It is only fair to state that a large majority of our patients come to us in a very chronic stage of the disease and may be termed "last resorters." The results in this group of patients have been most gratifying. The majority have made definite and sustained improvement. A few made dramatic recoveries, and a few were unable to accomplish any distinct gain at all. As has been stated before, the number of variable factors is so great that no proof can be offered as to the specific role played by climate in this group of patients. It is equally difficult to evaluate any other type of therapy. We were, however, convinced by comparing their previous experiences with various types of treatment, that climate played a very important role in the improvement secured.

The total effect of climate is a composite of such things as humidity, temperature range, altitude, barometric pressure, wind velocity, rainfall, concentration of ultra-violet, total sun energy, ionization of air, type and character of exposure to sun, etc. We are now attempting to determine which are the significant factors. Graphic records are being kept on all of the above data and these are being studied in conjunction with the patient's signs and symptomatology. A warm, dry climate and a minimal barometric variation at present seem essential. Various forms of heliotherapy constitute the major portion of specific climatic therapy.

The Rational Treatment of Bone Tuberculosis. By Charles K. Petter, M. D., Oak Terrace, Minnesota, Department of Surgery, University of Minnesota and Glen Lake Sanatorium, Oak Terrace, Minnesota, in The Journal of Bone and Joint Surgery, 15:4:986, October, 1933.

There are really three schools of therapy in bone tuberculosis. First, the heliotherapists, who feel that solar therapy and prolonged general rest bring about better results than the surgeon's knife. Such a regime requires long periods of hospitalization. In our country this is economically bad, except in children, and does not as a rule produce bony ankylosis. One point in favor of the treatment advocated by this group, however, is the fact that all lesions in all parts of the body are benefited by the regime while the particular lesion in question is being treated.

The second group believe in ambulant treatment with brace or cast, or else they immediately perform an arthrodesis, lay in a bone graft, or amputate a member, without examining more of the patient than the particular portion causing local symptoms.

Therefore, as the third school, let us employ the following general hygienic measures, plus heliotherapy, using those orthopaedic appliances which are indicated until the optimum conditions obtain for surgical intervention:

1. An improvement of the general condition of the patient.
2. Demonstration of patient's ability to combat the disease.
3. A quiescence of the destructive process in the bone, and
4. A favorable state (quiescence of activity, of other tuberculous foci).

In a series of bone cases at Glen Lake Sanatorium treated entirely without surgery the average number of hospital days was 1,115, while in a series of cases treated by general therapy plus surgery the period of hospitalization was reduced to 682 days. Follow-up records in the first group showed recurrence or reactivation in twenty per cent, occurring within the first two years after discharge, while in the second series, followed from one to three years after operation, the figure was two per cent.

Triorthocresol Phosphate Poisoning Due to the Ingestion of Adulterated Jamaica Ginger. Orren P. Goodwin, M. D., Veterans' Administration Facility, Alexandria, Louisiana, in Medical Bulletin of the Veterans' Administration, 10:2:110, Oct., 1933.

During 1930 the author had the opportunity of observing a number of cases of polyneuritis caused by the ingestion of Jamaica ginger which had been adulterated with triorthocresol phosphate.

Several theories had been advanced as to the causative agent of this type of polyneuritis before its true etiology was definitely demonstrated. One of the first was that it was due either to lead or arsenic poisoning, but chemical analysis soon demonstrated the fallacy of this belief. Infection was also thought of, due to the fact that the incubation period was so long between the time of taking the beverage and the development of paralysis.

The affected patients in our series usually gave a history of awakening with pain in the calves of their legs. This pain gradually disappeared and was followed by a sensation of numbness. The knee-jerks were sometimes normal, but more frequently exaggerated. The ankle-jerks were absent, as were the plantar reflexes. No ankle clonus was elicited. There was greater weakness of the flexor than of the extensor muscles. There was no pain in the course of the sciatic nerves, nor on extension of the legs. Usually there was rigidity of the calf muscles, but no pain on deep pressure and no subjective complaint of pain. The condition became progressively worse, so that in a few weeks the patients were unable to move feet or toes. Paralysis of the muscles below the knees was complete. The feet were moist, the toes and heels syanotic. Symptoms referable to the eyes or gastro-intestinal tract were rare. In a few cases there was subsequent involvement of the upper extremities.

Severe cases showed marked bilateral foot-drop, with involvement of all muscles supplied by the external popliteal. There was always a steppage gait. Seated on his bed, the patient may raise his feet, which is accomplished mostly by the extensor longus digitorum, while the tibialis anticus and extensor proprius hallucis have very little strength. The muscles supplied by the internal popliteal nerves (gastrocnemius and soleus) are usually weak, but have fair movement. There may be tenderness at the neck of the fibula at the point where the external popliteal nerve passes over it, and also tenderness on pressure over the peroneal group of muscles. There is no response to plantar stimulation. There may be hypesthesia of the dorsum of the foot, but no absolute sensory loss. Weakness or sensory changes in the upper extremities depends on the severity of the case. All cases give the history of first having had pain in the calves of the legs.

Involvement of the upper extremities begins about one week after the appearance of first leg pains and commences with pain and soreness in the fifth finger of the hands. Wasting of the hands soon begins, and the patients become unable to approximate thumb and fingers or pick up small objects. They can close the hands tightly and extend the fingers. Atrophy is usually pronounced in the legs, especially in the anterior tibial group. In the hands the thenar and hyperthenar eminences, the abductor pollicis and interossei muscles all show atrophy. The muscles of the thighs and forearms show no loss of power, but there is a spacticity in passive movement. The triceps, biceps, and patellar reflexes are all exaggerated, particularly the last. The plantar reflexes are markedly exaggerated. The tendon Achilles reflex is lost. The hands exhibit the "apelike" deformity of ulnar paralysis, with partial involvement of the medical (ulnar group). Both the external and internal popliteal nerves may be completely paralyzed.

Differential Diagnosis

Among diseases from which this condition, "jake paralysis," must be differentiated are tabes dorsalis, multiple sclerosis, occupational neuritis of severe type, transverse myelitis, and anterior poliomyelitis. Trans-

verse myelitis will cause a bilateral paraplegia of rapid onset, but the sensory loss is usually as complete as the motor, there is sphincter involvement and the knee kicks are diminished, as well as the ankle-jerks. Tabes is a posterior cord disease causing lost knee-kicks and ataxia and without typical toe-drop of sudden onset. The spinal fluid test is also positive. Multiple sclerosis usually shows a spastic paraplegia of slow onset and without bilateral toe-drop. We also find the intention tremor, pale temporal disks, absent abdominal reflexes, scanning speech, and lively lower reflexes. Anterior poliomyelitis of the paraplegic type is often misleading, but we have a lost knee-kick and early spinal fluid changes; also, the paralysis is irregular or crossed. Polyneuritis from arsenicals occurs only in chronic cases with slow onset, respiratory disturbances and marked sensory changes. Later, pigmentation of the skin, sweating and skin eruptions appear. Lead poisoning is slow in onset, and is usually accompanied by constipation, colic, and severe anemia. The lead line appears on the teeth and there is stippling of the red blood cells. The palsy is selective, especially in the muscles of the forearm, while in "jake paralysis" the polyneuritis invariably appears first in the lower extremities. Alcoholic neuritis comes on slowly with marked sensory changes and painful conditions affecting especially the feet. All of the general symptoms of chronic alcoholism are usually present, and not infrequently marked mental symptoms occur, such as those seen in Korsakoff's syndrome.

Prognosis

Follow-up contacts with the patients in this series three years after treatment showed that the milder cases recovered in about fifteen months. Where there was involvement of the hands, recovery did not take place under two years. In severe cases, paralysis below the knees tended to persist long after all symptoms had disappeared in the upper extremities.

Treatment

Unfortunately there is no antidote for the poisonous adulterant, since the paralysis occurs so long after the ingestion of the Jamaica ginger. The only recourse is after care of these patients. Massage, muscle training, mild galvanism, rest, and warmth are indicated.

The Undernourished Child. By Howard L. Eder, M. D., Santa Barbara, California, in Arch. Pediat., L:9:628, September, 1933.

There are many causes for undernourishment in children. Mere lack of food, particularly in times of depression and famine, will account for many cases. Others may have an adequate amount of food, but reject it because of its preparation. We must also take into consideration the problem of sufficient rest, remembering that some children require more than others. Economic conditions forcing the child to be placed in a public institution often cause dissatisfaction on the part of the child, thus creating an uncooperative spirit. A very frequent cause of malnourishment is traceable to a mother's indulgence in permitting a child to disregard a schedule by arising late for breakfast and eating between meals. Weight loss subsequent to an acute illness is usually rapidly regained but may, in some cases, result in a prolonged state of undernourishment. Chronic disease, particularly infected tonsils, tuberculosis and asthma, is the underlying factor in many cases and should be given due consideration in the treatment. Parasites, particularly intestinal worms, malaria and scabies, should be ruled out. Every underweight case should be considered from an endocrine and vitamine deficiency standpoint. Rare cases may be accounted for by neoplasms or constitutional inferiority.

Many attempts have been made to eliminate this social menace—the undernourished child. Some communities have established cafeterias in the schools in order that those children who live at a distance may have a warm meal at noon. In others, milk and crackers are given at recess time. Preventoriums have been established in a few cities. These institutions are an ideal change from the home environment, and, if properly supervised, the desired results are obtained in a minimum of time.

Santa Barbara has a preventorium called Sunshine Cottage with a bed capacity to accommodate ten boys and ten girls. This institution is situated about four miles outside the City limits. It is sponsored by the Junior League and receives financial aid from the Community Chest, Christmas Seal sales and revenue from pay patients.

The daily routine of the Cottage begins with a cold shower at 6:30 A. M., followed by breakfast. After breakfast the children make their beds, after which they go to their school classes until 10 o'clock. An hour sun bath at this time is followed by another cold shower, after which school is resumed for an hour and a half, followed by dinner at 12:30 P. M. The afternoon begins with a two-hour rest period. At 3 o'clock temperatures are taken and fruit juice is given. Following this, the upper grade children attend another session of school. Supper is at 5:30 P. M. The routine of the day is thus ended and play time or story hour occupies the remainder of the time until 7 o'clock, at which time the children go to bed in their sleeping porch dormitories.

The diet consists of good, wholesome food. Three hearty meals are served daily with no restrictions on the amount any child may eat. It is never necessary to force food upon them, as they invariably ask for a second or third helping after they have become adjusted to the new routine.

When a child enters the Cottage, his undernourished condition is frequently accompanied by a mild secondary anemia. He is therefore given a tonic containing iron until his improvement justifies his being placed on routine cod liver oil.

We feel that posture plays an important part in a child's physical development. This is stressed in Sunshine Cottage and each child is examined periodically by Dr. Atsatt, an orthopedic surgeon, who recommends specific treatment and exercises. These recommendations are carried out by a trained physiotherapist.

Electrobasographic Method of Recording Gait. R. Plato Schwartz, M. D., Arthur L. Heath and John N. Wright, Rochester, N. Y. Arch. Surg., 27:5:926, November, 1930.

Summary

Medicine, general surgery, neurosurgery, industrial surgery and orthopedics have to do with the treatment of patients suffering from lesions which produce disturbances in gait.

A method of recording gait is as essential to the proper treatment of abnormal gait as is the electrocardiograph in the treatment of heart disease, or the thermometer in the recording of temperature.

Such clinical advantages may be provided by that method of recording gait which will meet the following conditions:

(A) It must assure simplicity of procedure, minimum time requirement, and economy.

(B) The mechanism must be free from alterations in the record due to technical errors.

(C) Evidence must prove that changes in successive records made of the same patient's gait are due only to the way the patient walked on successive dates. Such records would then give evidence of the presence or absence of improvement under recorded conditions.

We have offered the premise that abnormalities in gait may be defined in terms of the duration in weight-bearing time on the heel, the fifth metatarsal and the great toe of the respective feet.

The electrobasographic method of recording gait photographs the duration of time that weight is borne on the heel, the fifth metatarsal and the great toe of each foot, using the patient's own shoes.

Data in the form of patient's records of gait have been presented to support the belief that the electrobasographic method of recording gait fulfills the provisions essential for providing the clinical advantages as outlined in third paragraph of summary.

Some Applications of Physical Therapy in Medicine. By Louis J. Gelber, M. D., Clinical Instructor, Physiotherapy Department, Newark Beth Israel Hospital, Newark, New Jersey, in Radiology. XXI:3:274, Sept., 1933.

Gastro-Intestinal Motor Insufficiency

In studying the motor phenomenon of the gastro-intestinal tract, it is essential to have x-ray films made of the entire system. This will always give us a clue, if any organic pathology, such as ulcer or cancer, is the cause of motor insufficiency. However, once organic pathology is ruled out, the cause for the functional disturbances must be ascertained.

In the study of the colon for motor insufficiency and stasis the barium enema is the best method.

Gastro-Intestinal Treatment

In the treatment of gastro-intestinal diseases, we must resort to surgery, if ulcer or malignancy exists. On the other hand, if localized muscular inability or lack of function exists, especially in the colon, some mechanical action, such as diathermy or galvanism, should be instituted.

The restoration of the tone of sluggish muscles and nerves by hand manipulation and massage was in use long prior to the various electrical modalities of today.

Physical Therapy as Applied to Gynecology

Diathermy has been used with good results in many gynecologic clinics, not only in cases of pelvic infection but also in post-operative adhesions.

The abdominovaginal method is employed. Here we place our active electrode in the vagina, put a plate, our inactive electrode, over the abdomen, and use the d'Arsonval current for an allotted time, depending on the lesion we are treating. This method is often used in treating inflammatory diseases, Neisserian infections, and post-operative adhesions. For clearing up such cases as cervicitis and endocervicitis, we rely mainly on electrocoagulation, using a fine-pointed needle as our active electrode.

The part that heat plays in curing disease has long been known. We are familiar with the fact that body heat is a good culture medium for bacteria; any elevation from this temperature has a deterrent effect on bacterial growth. Furthermore, increased heat causes increased circulation, with an out-pouring of leukocytes and antitoxin and a resultant phagocytosis. General metabolism is also speeded up, and the weakened and diseased part under treatment is given further aid.

In treating gynecologic diseases by diathermy, the abdominovaginal method is the one of choice, due to the fact that most heat is generated at the point at which the pathway of resistance is less. An 8x10 electrode is placed over the lower abdomen and a vaginal electrode is inserted into the vagina posterior to the cervix. From 1,200 to 1,600 ma. are given, according to the tolerance of the patient.

Contra-Indications

There are certain definite contra-indications. Diathermy should never be used in the presence of an acute condition, especially if pus has not been evacuated. In cases in which ovarian cysts or tumors are present, the bipolar current is contraindicated. It should never be used during menstruation, or if open vessels exist. It is, therefore, essential that one select proper cases for diathermy, as success or failure in choice determines the prognosis of the patient.

A word might be said also of the use of galvanism in gynecologic diseases. If we bear in mind that the positive pole tends to shrink tissue, we can readily see tthe result of applying this pole to a large, boggy edematous uterus. Galvanocautery is also used in the treatment of endocervicitis.

Temperature of the Gastro-Intestinal Tract. The Effect Thereon of Hot and Cold Foods and of Physical Therapeutic Agents. By Joseph S. Hepburn, Ph. D., Harry M. Eberhard, M. D., Rowland Ricketts, M. D., and Charles L. W. Rieger, M. D., Philadelphia, in Arch. Int. Med., 52-4:603, Oct. 1933.

A wide difference of opinion exists among surgeons and internists concerning the value and action of the ice bag and the different forms of heat, applied locally, in the treatment of acute appendicitis, ulcer of the stomach or duodenum and other pathologic processes within the abdomen. In many patients, gastro-enteric upsets occur after the ingestion of ice cream, ices and iced drinks. This research, therefore, was undertaken in order to ascertain the influence exerted on gastro-intestinal temperatures by (a) the ingestion of hot and cold foods and drinks, and by (b) the local application of cold and of various forms of heat.

Technic

In these studies, use was made of a resistance thermometer of insulated nickel wire mounted in a silver tube one inch (2.5 cm.) in length and one-fourth inch (0.63 cm.) in outside diameter. This thermometer was attached to a resistance thermometer recorder by means of insulated copper wires contained in a flexible rubber tube approximately one-fourth inch in external diameter.

For measurement of the gastric temperature, the thermometer was introduced in the same manner as a stomach tube. For measurement of the temperature of the upper part of the intestine, the thermometer was introduced in the same manner as a duodenal tube for nonsurgical biliary drainage.

The subjects were chiefly technicians and students in the schools of medicine and nursing. They were all healthy and active. In all the experiments except those on the sigmoid, the subject had an empty stomach.

Temperature of the Gastro-Intestinal Tract

In 129 men, the maximum gastric temperature was 101.8 F., the minimum 97.8 and the average 99.2. In 128 women, the maximum was 102.2 F., the minimum 97.5 and the average 99.4.

Comparison of Gastric with Oral Temperature.—In 124 of the men and all of the women, the temperatures

of both the stomach and the mouth were taken. In both sexes, the gastric temperature usually was higher than the oral temperature, the average difference being 0.9 F. in the men and 1.25 F. in the women. In individual men, the gastric temperature was as much as 0.8 F. lower and as much as 3.1 F. higher than the oral temperature. In individual women, the gastric temperature was as much as 0.6 F. lower and as much as 4.4 F. higher than the oral temperature.

Influence of Hot and Cold Foods on Gastric Temperature

Ice Water.—The subjects included 27 men and 25 women. Each subject drank 250 cc. of ice water, the temperature of which was measured by means of a mercury thermometer immediately prior to ingestion. An immediate, marked decrease in gastric temperature resulted; this was followed by a rise, at first quite rapid, then progressively slower; finally the curved graph again became a straight line which recorded exactly the same temperature for at least 10 minutes. This constant temperature was taken as the final temperature or temperature after recovery; it was approximately the same as the initial temperature, but tended to be a few tenths of a degree lower than the latter. Thus, with each sex, the average of the final temperatures was 0.2 F. lower than the average of the initial temperatures. The time measured on the graph from the drop in temperature on ingestion of the ice water to the beginning of the constant final temperature was the recovery time.

Ice Cream—As with ice water, the final temperature of the stomach was approximately the same as its initial temperature, but tended to be a few tenths of a degree lower than the latter; with each sex, the average difference between initial and final temperature was 0.2 F.

The magnitude of the decrease in gastric temperature apparently depends on the temperature of the ice cream, the time taken for its ingestion and the subject.

Hot Coffee.—On ingestion of hot coffee, an immediate, marked increase in gastric temperature occurred, followed by a decrease. At first rapid, then progressively slower; finally, the graph again became a straight line which recorded exactly the same temperature for at least 10 minutes. The final temperature of the stomach tended to be slightly higher than its initial temperature, the average difference between the two temperatures being 0.1 F. The time required to drink the coffee was from 0.18 to 4.12 minutes. The increase in gastric temperature ranged between 4.2 and 17 F., and the recovery time between 19.9 and 45 minutes, exceeding 30 minutes in seven experiments.

Influence of Physical Therapy on Gastro-Intestinal Temperature

Study was made of the influence on visceral temperature of the following forms of physical therapy: ice bag, hot wet pack, hot water bag, electric pad, infra-red lamp and diathermy. In one series, each form was applied over the true epigastric region. In another series, each form except the hot wet pack was applied over the region of the upper part of the intestine. There were twelve gastric hot wet pack experiments, divided approximately equally between the two sexes. The other experiments included thirty-four on the stomach and thirty-one on the upper part of the intestine; they were divided approximately equally between the two sexes, and between the five forms of physical therapy.

The maximum skin temperatures observed during the application of the various forms of heat therapy were: hot wet pack, 109.4 F.; hot water bag, 129.2; electric pad, 134.6; infra-red lamp, 136.4, and diathermy, 105.8. The minimum skin temperature observed during the application of the ice bag was 44.6 F.

The period of application of the physical therapeutic agent extended from 35 to 140 minutes, and exceeded an hour in all but eleven of the seventy-seven experiments.

No distinct and uniform tendency to produce either an increase or a decrease in visceral temperature was observed on the application of the hot wet pack, the hot water bag, the electric pad or the infra-red lamp.

On application of the ice bag, a distinct tendency existed for a decrease in the temperature of the stomach and of the upper part of the intestine. In one experiment, an ice bag was applied for ten minutes to the anterior body surface over the sigmoid with the subject in the Sims position; it produced no appreciable change in the sigmoidal temperature.

On application of diathermy, the visceral temperature uniformly increased, the average increase being 1 F. One man was used in two different experiments on the influence of diathermy on duodenal temperature. In each experiment, the period of application was approximately an hour. In one experiment, the milliamperage was gradually increased from 1,000 to 2,900, and the duodenal temperature increased 1 F. In the other experiment, the milliamperage was kept constant at 1,600, and the duodenal temperature increased 1.2 F.

As stated before, the subjects were in the supine position, and the physical therapeutic agent applied to the anterior surface of the body, since this is the usual clinical procedure. However, one experiment was made with a subject in the prone position in order to bring the abdominal viscera closer to the agent. When in the supine position the subject had shown a slight increase (0.5 F.) in gastric temperature with a hot wet pack. In the prone position, with an electric pad at high heat, her gastric temperature increased by 0.2 F.

None of the observed changes in visceral temperature exceeded the maximum variation in gastric temperature during similar periods of time as reported previously.

The application of heat to the abdomen produces a feeling of comfort when localized or general pain exists. However, in view of the results obtained in this research, the production of any reparative benefit by local application of heat or cold is conjectural. It is doubtful that the benefit obtained is sufficient to warrant subjecting the patient to the various local applications of heat, especially in summer. Consultation with several physiologists has not produced any explanation of the process resulting in the feeling of comfort. The results also render debatable the use of ice locally for the control of gastric or intestinal hemorrhage, and the local application of heat to promote the healing of gastric or duodenal ulcer.

Electrosurgery in Otolaryngology. Indications and End Results. Lewis J. Silvers, M. D., New York, in Arch. Physical Therapy, XIV:8:494, August, 1933.

Indications for Electrosurgery

Electrosurgical tonsillectomy is not a substitute for the radical enucleation. Each has its special field of usefulness. The cases best suited for electrosurgical tonsillectomy are:

1. All incomplete post-operative cases, tags, stumps and cicatrices. Lymphoid islands appearing shortly after surgical enucleation are quickly removed and recurrent nodes prevented.

2. The entire gamut of pathological cases where radical surgery is contraindicated or considered unsafe; Hemophilia; Diabetes, Tuberculosis, Malignancy, Hyperpiesis and Physical Debility come first to mind. The aged and those refusing radical operative interference come next.

3. Many obstinate mycotic infections respond readily to the electrosurgical technic, as described by the author. Lingual tonsils, varices and tubal tonsils occupying the fossa of Rozenmuller are peculiarly adapted to this newer mode of treatment. It is indicated in the chronic suppurative otitis media, where the discharge is prolonged by granulations and accessible cholesteomata. A properly insulated ear applicator will quickly destroy the offending pathological tissue, when accessible. Diathermocryptectomy is peculiarly adapted to those cases where a strumatous diathesis is present. Clinically, we have noted a definite relationship between the thyroid and the tonsils in certain individuals.

Adenoids and infected adenoid remnants can be removed more effectively by a retronasal diathermy electrode. The crypts and crevices may be reached by the penetrating heat and infection eliminated from this common focus.

The removal of tonsils in children by electrosurgical means has to be carefully considered. I inform every patient of the tediousness of the properly executed technic and insist upon their cooperation in procuring the desired end-results. The observance or non-observance of extreme care to avoid epithelialized tissue, such as the plicae semilunaris and triangularis in close contact with the palatoglossis and palatopharyngeus muscles spells success or failure in obtaining the perfect tonsillectomy. The recent work of Fowler on the surgical anatomy of the tonsil brings to light a most significant finding which greatly affects our approach to the remaining tonsillar stumps. This writer revealed a muscle which attaches the capsule of the tonsil to the aponeurosis of the constrictor muscle which he called the "Tonsillo-pharyngeus." We now may leave these fine muscular strands at the equator of the tonsil and rest assured that fresh lymphoid tissue will not recur. This muscular attachment of the tonsil accounts for the difficulty often encountered in our careful dissection of the nodes. Profuse bleeding which is sometimes met with here is to be attributed to the larger vessels which follow these muscular fibres.

End Results Obtained by Electrosurgery

1. A complete tonsillectomy is now possible by electro-surgery. No scar tissue or damage to normal structures should be noted with the execution of the proper technic.

2. As an adjunct to the incomplete orthodox surgical tonsillectomy, electrosurgery is a valuable method. Tabs, cicatrices, cicatricial contraction and lymphoid islands appearing a year after operation are quickly and effectively destroyed.

3. A minimum of five treatments on each tonsil is essential to performing a good tonsillectomy without incapacitating the patient in any way.

4. A shockproof, nearly bloodless tonsillectomy is possible when the proper skill in electrosurgery and a thorough knowledge of the anatomy of the throat are mastered.

5. Electrosurgery, being controllable from start to finish of operation, permits a multi-stage technic to replace the more radical single stage operation. This makes operation possible by electrothermic methods wherever radical surgery is contraindicated.

6. By following the author's modification of simple electrocoagulation, secondary hemorrhage may be averted. An analysis of over one thousand cases covering a period of nine years, has led the writer to conclude that time must be sacrificed for safety. Marked discomfort and possible serious secondary hemorrhage may follow the single stage operation.

7. Malignant and tuberculous tonsils which are otherwise inoperable, are peculiarly suited to the electrothermic technic.

8. Obstinate mycotic infections respond readily to this method.

9. Lingual tonsils, tubal tonsils and varices offer an ideal field for the high frequency current.

10. Electrocoagulation of the turbinates frequently avoids more radical nasal surgery with better end-results. Nasal mucosa suffers a minimum of trauma of this technic.

11. Diathermy is not only an adjuvant in the treatment of nasal accessory sinus disease, but often is the means of averting more radical surgery.

12. For perfection of end-results patients should be seen six weeks, six months, and finally one year after total extirpation of the tonsils.

Book Review

INFECTIONS OF THE HAND. By Allan B. Kanavel, M. D., Sc. D., Professor of Surgery, Northwestern University Medical School, new 6th edition. Pp. 552, 216 illustrations, price $6.00, Philadelphia, Lea & Febiger, 1933.

The after treatment of patients suffering from injuries and infections of the hand is one of the most difficult problems that come to the physical therapist. This book is by one of the world's authorities on this subject. Its value to the physical therapist cannot be overemphasized. Dr. Kanavel expresses this as follows: "The primary requisites in the treatment of hand infections are an adequate knowledge of the anatomy of the hand, of the underlying pathological process present, and of the proper methods of surgical treatment. Of equal importance in securing a perfect result is a comprehensive knowledge of the various methods of treatment which will bring about a restoration of function after the infection has been controlled." This statement from a surgeon should make every physical therapist desirous of knowing what this surgeon believes these methods to be.

There are four chapters in this book that should be read by every physical therapist. The chapter on "Function of the Hand in Relation to Infections" gives the best conception of the physiology of the hand that we have seen. To preserve and restore the functions of the hand it is necessary to have a knowledge not only of the anatomy but of the functions of the individual units as well as those of the hand as a whole, and to know the position of function of the hand in which the maximum power may be exerted with the least effort.

The general principles of treatment of these infections should be known by every physical therapist as several of these principles involve the use of physical agents. Bier's passive hyperemia and the use of an electrically heated chamber in the application of hot moist dressings are considered.

The American Physiotherapy Association can be pleased that the author thanks one of their well known members, Miss Gertrude Beard, for her critical knowledge in dealing with the chapters on physical therapy.

The chapter on "Physiotherapy After Infections of the Hand" deals definitely with the time to start physical therapy and gives many valuable suggestions on the variations in technic useful in hand conditions. This is especially useful in the description of the required exercises. The illustrations of the table known to us as the "Kanavel Table" will enable any carpenter to make it. There are on this table ingenious devices for stretching the flexor tendons of the fingers and wrist, for promoting abduction and adduction of the fingers, for stretching scar tissue between the fingers, for exercising the flexor and extensor muscles of the fingers, thumb and wrist.

The fourth chapter mentioned is on "The Use of Splints After Infections of the Hand." To secure results in these hand conditions it is important that physical therapy is supplemented by the use of various types of splints designed to bring the hand and fingers into the "position of function," stretch tendons and fibrosed muscles, and mobilize adhesions. Four basic splints to do this work, are here described and illustrated.

As already stated this monograph is undoubtedly the most authoritative and comprehensive work on infections of the hand, published in recent years, and should be in the hands of everyone interested in physical therapy in traumatic surgery.

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